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Epithelial neoplasms of the salivary glands: their histology and their behavior

■ *Donald A. Kerr,* D.D.S., M.S., Ann Arbor, Mich.*

A biopsy or frozen section examination is desirable before excision of epithelial neoplasms of the salivary glands since the facial nerve, which may be preserved in the case of benign neoplasms, should be sacrificed as a part of the wider excision and more elaborate treatment necessary if malignant neoplasms are present.

The term salivary gland tumors designates a group of neoplasms of varied type and unlimited histological variation. The variations in type and histological characteristics and the small number available for individual study have produced confusion in nomenclature, classification, and the understanding of the natural history of the salivary gland lesions. Because of poor understanding of the natural history of these neoplasms, treatment often has been unwittingly inadequate.

Recently some reasonably large series of cases have been studied in an attempt to correlate histological pattern and the clinical behavior of the neoplasms. Examples of the more precise types of tumors will be shown, the terms used to classify them designated and their clinical behavior indicated. Such a compilation of information may provide a more complete understanding of these lesions and a more rational treatment.

In 1953 Buxton, Maxwell, and French[1] made a detailed study of 280 patients with parotid gland tumors and attempted to correlate the histological pattern with the clinical behavior evidenced by follow-up of the patients so that the tumors could be segregated into groups with a predictable behavior.

In 1954 Foote and Frazell[2] reported a study of 900 cases with emphasis on histological classification and analysis of the natural history of the separate tumor types.

Although from these two studies an identical classification did not evolve, the two classifications can be reconciled. The

results of these two studies will be used primarily in the present discussion.

For comparison and clarification of terminology, both classifications are submitted with slight modifications.

■ *Classification*

The classification of Buxton, Maxwell, and French is as follows:

Benign epithelial tumors
- I. Mixed tumors
  - A. Stromal elements predominating
    - 1. Cylindromatous type
  - B. Epithelial elements predominating
    - 1. Canalicular type
- II. Mucoepidermoid tumor
- III. Adenomas
  - A. Serous cell
  - B. Acidophilic
    - 1. Papillary cystadenoma lymphomatosum

Malignant epithelial neoplasms
- I. Squamous cell carcinoma
  - A. Cornifying
  - B. Noncornifying
  - C. Lymphoepithelioma
- II. Gland cell carcinomas
  - A. Pseudoadenomatous basal cell carcinoma
    - 1. Cylindromatous, canalicular, medullary, and cystic forms
  - B. Acidophilic gland cell carcinoma
  - C. Serous cell adenocarcinoma
- III. Mucoepidermoid carcinomas
- IV. Unclassified

The classification of Foote and Frazell is as follows:

- Mixed tumors
  - Benign mixed tumors
  - Malignant mixed tumors
- Mucoepidermoid tumors
  - Low grade tumors
  - High grade tumors
- Squamous cell carcinoma
- Adenocarcinomas
  - Adenocystic
  - Miscellaneous forms
    - Trabecular, solid, anaplastic, mucous cell, pseudoadenomatous pattern
- Acinic cell
- Papillary cystadenoma lymphomatosum
- Oxyphil adenoma
- Sebaceous cell adenoma
- Benign lymphoepithelial lesions
- Unclassified tumors
  - Benign
  - Malignant

These two classifications are basically the same but with slightly different terminology. The lesions designated adenocarcinoma by Foote and Frazell are designated gland cell carcinoma by Buxton, Maxwell, and French. The adenocystic carcinoma with its various types is comparable to the pseudoadenomatous basal cell variants of different types. Mucoepidermoid tumors of low and high grade of Foote and Frazell are the same as the benign and malignant types of Buxton, Maxwell, and French. In this discussion the classification of Buxton, Maxwell, and French will be followed.

The salivary gland tumors are primarily resident in the parotid gland with less than 20 per cent occurring in the lesser and accessory salivary glands. Some varieties occur in the parotid gland which are not found in the lesser glands. Some varieties, such as the pseudoadenomatous basal cell variants, occur with greater frequency in the accessory glands than they do in the parotid. The behavior of the neoplasm in the accessory and lesser glands is essentially the same as in the parotid gland so that what is learned of clinical behavior of parotid tumors is applicable to those occurring in the lesser or accessory glands.

■ *Mixed Tumors*

The mixed tumor is a benign lesion which provides the majority of the tumors arising in both major and minor salivary glands. It has an infinite number of histological variations which in some instances, because of squamous metaplasia or atypical morphology, makes distinction between benign and malignant equivocal.

Of the 200 cases in Buxton, Maxwell, and French's series, 183 (91.5 per cent) presented characteristics of benign mixed tumors. In Foote and Frazell's series, 494 of the 877 (56.3 per cent) were in the benign mixed tumor group. The mixed tumor contains epithelial and connective tissue elements in all conceivable proportions, arrangement, and levels of differentiation. These tumors are in some instances malignant, and differential diagnosis may be difficult because of the wide range of histologic features and levels of differentiation.

When seen by the surgeon, the tumors are most often located in the parotid gland and appear as round, smooth, freely movable firm tumors from 2 to 5 cm. in size, although if untreated, some may become very large. Often they have been present for some time without symptoms other than deformity. The primary tumor usually appears as a single encapsulated mass, whereas recurrent tumors are multiple and poorly encapsulated. Those occurring in the accessory salivary glands are most frequently seen in the vestibular and buccal mucosa or the palate as small, smooth, semi-solid, freely movable, asymptomatic nodules.

The histogenesis is poorly understood, and the theories concerning its origin reach all realms of speculation. The most widely accepted theory is that it originates from adult glandular epithelium, although the theory of origin from embryonal epithelial cells still has considerable support. There is little evidence to support the theory of mesenchymal and developmental origin. It is my opinion that the tumor is epithelial in origin and that mesenchymal changes are produced by the influence of the proliferating epithelium and vascularity of the tumor on connective tissue. With variable vascularity of the tumor, there is much variation in the polymerization of collagen which varies the degree of desmoplasia in different tumors or different parts of a tumor.

The most characteristic microscopic feature is the extreme variation in histological pattern. No two tumors present the same picture, nor do two parts of the same tumor present the same features. It would be impossible to describe all of the variations exhibited by the mixed tumors. They are composed of stellate to spindle cells growing singly or in groups and sheets with some varying tendency to produce a tubular pattern. The epithelial elements have some tendency to undergo metaplasia to squamous epithelium and produce keratohyalin. The epithelial elements are interspersed in connective tissue which varies from myxomatous to hyalin or chondroid in character (Fig. 1-4).

There is no apparent correlation between histological characteristics and tendency to recurrence, nor is there a tendency to change in level of differentiation with recurrence. The frequency of recurrence results from incomplete encapsulation and the tendency for tumor extensions outside the pseudocapsule. This

favors incomplete removal and enhances recurrence.

The natural history of the tumor provides valuable information, and if this can be correlated with the histological pattern, a more accurate prognosis can be given. In Foote and Frazell's study, 60 per cent of the tumors were in females. The median age was 42 years. The youngest patient was 11 years old. Buxton, Maxwell, and French reported ten patients under 21 years of age and four under 12 years of age. Follow-up studies by Buxton, Maxwell, and French are as follows:

No. of patients	Time
63 —	Less than five years
70 —	5-10 years
40 —	10-15 years
9 —	12-20 years

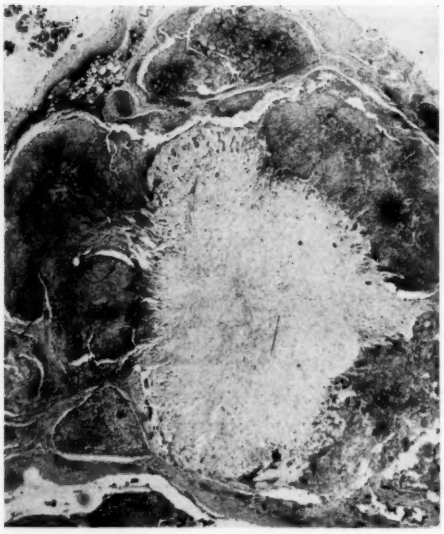

Fig. 1—Mixed salivary gland tumor showing nodular mass character of tumor and daughter tumor masses outside of pseudocapsule. Central area demonstrates zone in which stroma predominates whereas in peripheral nodules cellular elements predominate

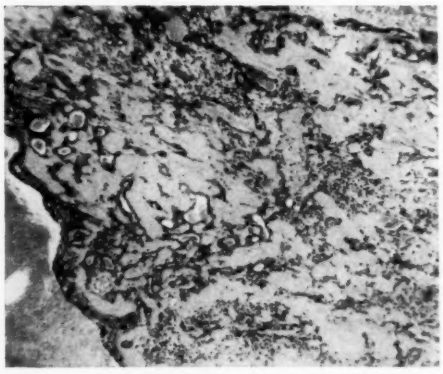

Fig. 2—Mixed salivary gland tumor. Boundary of microcyst. Cords of cells separating varying sized zones of stroma. Some adenomatous pattern present

The recurrence rate for the 183 patients with mixed tumor:

Single operation	
Alive without recurrence—	147
Dead without recurrence—	16
Alive with recurrence—	8
Dead—residual tumor—	1
Recurrence: 4.7 per cent	
Multiple operations	
Alive without recurrence—	10
Alive with recurrence—	1
Recurrence: 10 per cent	

These observations indicate the very benign nature of the mixed tumors and indicate that the prognosis is good with complete removal.

■ *Mucoepidermoid Tumor*

Stewart, Foote, and Becker[3] described the mucoepidermoid tumor and divided them into benign and malignant types according to their histological pattern and their clinical behavior. Clinical behavior is a much more reliable criterion of malignancy than is the histological pattern. The benign type appears to arise from ductal

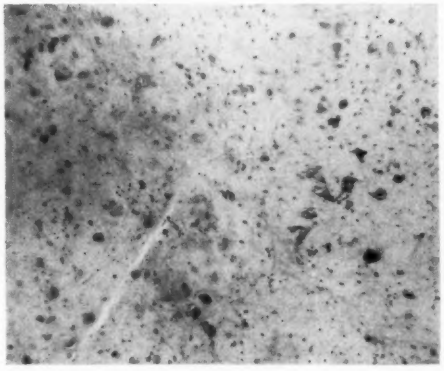

Fig. 3—Mixed salivary gland tumor. Minimal epithelial elements in dense stroma which has chondroid appearance

epithelium as the result of inflammation or obstruction. There is increased production of mucin by the ductal epithelium accompanied by squamous metaplasia of the ductal epithelium. Extrusion of mucin into the tissue initiates an inflammatory response and fibroblastic proliferation of a diffuse nature. There may be proliferation of the myoepithelial cells to produce an intermediate type of cell common to all tumors of this variety.

The histological features of the mucoepidermoid tumor are variable as are those of the benign mixed tumor. Basically there are three cellular components —the epidermoid cell, the mucous-containing cell, and the intermediate small spindle cell. The proportion of the types of cells is variable, but the intermediate cell usually predominates in the more aggressive tumors, whereas the squamatoid epithelial cells lining microcysts predominate in the low grade tumors. The mucin-forming cells may be numerous in the microcyst but are few in number in the solid cellular zones of the tumor. The benign variety has an abundant proliferating stroma with inflammatory cells scattered throughout. The tumor is divided into lobules and is encapsulated by the proliferating stroma. In the malignant variety there is more pleomorphism both of squamatoid cells and mucous cells. The intermediate cells exhibit hyperchromatism. There is less stromal proliferation and little evidence of encapsulation. (Fig. 5, 6).

The mucoepidermoid tumor occurs most commonly in women over 30 years of age as a painless swelling showing gradual enlargement. With complete local excision there is only slight tendency for recurrence. In the more malignant variety both sexes are affected equally. The age distribution is about the same as for the benign type (10 to 75) with over half of the patients being over 50 years of age. The lesion is characterized by pain which is often present when the tumor is small. The growth is rapid, indicating the aggressive nature of the neoplasm. In Foote and

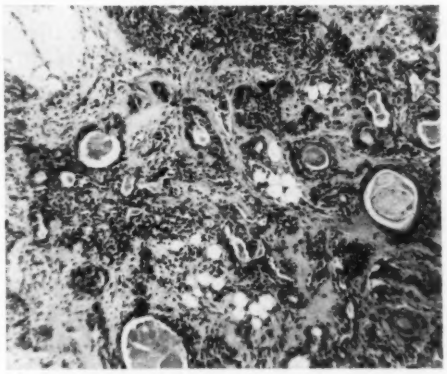

Fig. 4—Mixed salivary gland tumor. Cords and strands of epithelial cells in dense stroma. In areas suggesting acinar pattern, epithelium shows squamous metaplasia with keratin formation

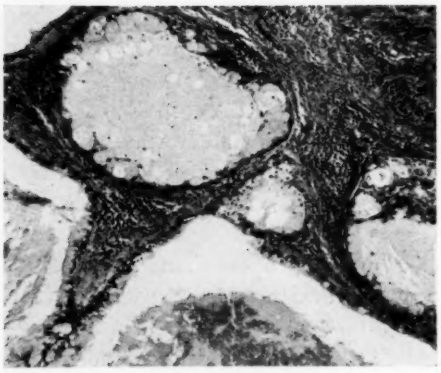

Fig. 5—Mucoepidermoid tumor of salivary gland. Cells lining microcysts retain ability to produce mucin. Prominent inflammatory response. In other areas of section, squamous cells line spaces

Frazell's series, the patients who were followed more than five years had regional lymph node metastasis in about two thirds of the instances and distant metastasis in about one-third. Slightly more than one fourth of the patients were alive and free of tumor after five years.

The difference in behavior between the two types makes positive histological differentiation mandatory for the outlining of adequate treatment and prognosis. Differential diagnosis is, in general, not very accurate as there has been a tendency to place any salivary gland tumor exhibiting squamous metaplasia in this category which would alter the pattern of natural behavior. The tendency to consider the malignant variety as a squamous cell carcinoma appears realistic, and the behavior is what would be expected of a squamous cell carcinoma.

The adenomas are rarer forms of salivary gland tumor which are characterized by rather typical cell morphology and staining characteristics.

■ *Serous Cell Adenoma*

The serous cell adenoma is characterized by clear cells which have an affinity for basic dyes but are negative for mucin, although positive for secretory granules. Small amounts of mucin may be found in dilated spaces which probably represent residual ducts. These appear to arise from acinar epithelium. The large clear cells grow in groups and nests separated by a delicate stroma. The cells are regular in pattern and staining characteristics. The tumors grow slowly and there may be a history of their having been present from 3 to 15 or more years. With complete local excision there is little, if any, tendency to recurrence. These tumors are rare in the major salivary glands, and occur even less frequently in the lesser salivary glands (Fig. 7).

■ *Acidophilic Cell Adenoma*

The acidophil adenoma or oxyphil cell adenoma or oncocytoma is a rare benign nodular tumor of small size (3 to 4

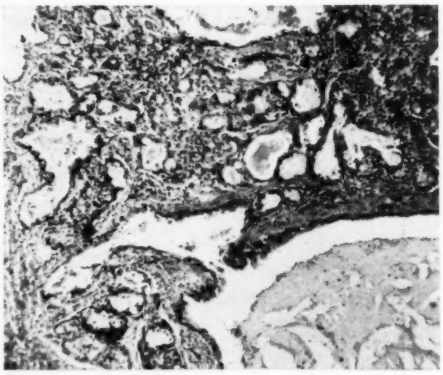

Fig. 6—Mucoepidermoid tumor. Microcysts, adenomatous pattern with squamous metaplasia zones of retained mucin

cm.) which occurs primarily in the parotid gland of patients over 60 years of age. The duration of the tumor may be from a few months to 15 or 20 years. The tumor is composed of nests and irregular cords of large cells having a bright pink cytoplasm and relatively small round nuclei. The cell boundaries usually are quite distinct and the cords or nests are separated by a very delicate stroma.

The acidophilic cell studied by Hamperl[4] in various organs were designated by him as oncocytes. Meza-Chavez[5, 6] demonstrated their presence in both acinar and ductal regions of about 20 per cent of parotid glands (9 out of 51), and it has been suggested by Meza-Chavez[5] and Thompson and Bryant[7] that the hyperplasia and acidophilic character of these cells is due to aging which perhaps helps to explain the incidence of this tumor in older people (Fig. 8).

■ *Papillary Cystadenoma Lymphomatosum*

Another rare adenoma found only in the parotid gland is the papillary cystadenoma lymphomatosum or Warthin's tumor. This is a small smooth globular, firm to fluctuant tumor which is found almost exclusively in males. The tumor may occur bilaterally. The best explanation of its origin is from salivary gland tissue of ductal type which is found in lymph nodes within or near the parotid. The proliferation of the ductal epithelium in a papillary pattern with the production of cystic spaces in a lymphoid stroma gives the tumor its name and produces its characteristic histological pattern. The cells making up the papillary projections and lining the cystic spaces are well defined,

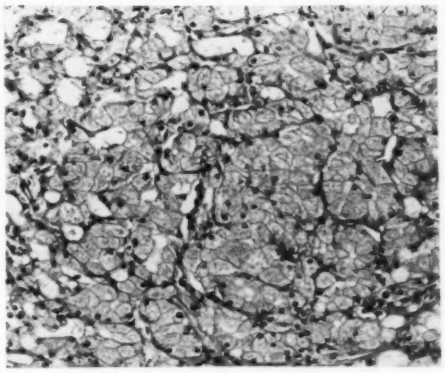

Fig. 7—Serous cell adenoma. Clear granular cells arranged in cords and nests separated by delicate stroma. Cords of cells stain bluish with hematoxylin and eosin

large acidophilic cells with small nuclei resembling oncocytes. The stroma is composed of lymphoid tissue. The tumors are always benign and usually are adequately treated by complete local excision (Fig. 9).

The benign lymphoepithelial lesions occasionally found in the parotid gland

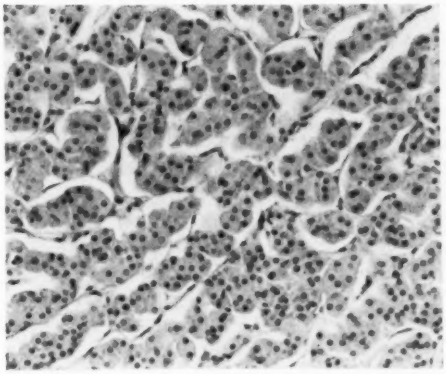

Fig. 8—Acidophilic cell adenoma. Large cells with abundant eosinophilic cytoplasm and small nuclei in cords separated by delicate stroma

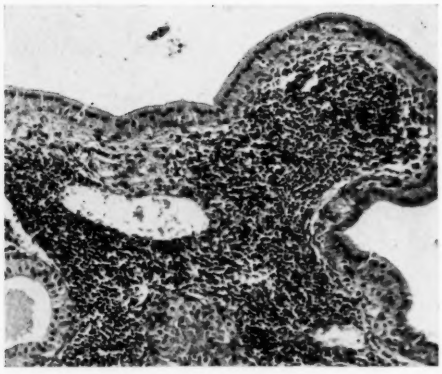

Fig. 9—Papillary cyst adenoma lymphomatosum. Small cystic spaces lined by tall eosinophilic cells in single layer. Papillary projections into cystic spaces. Delicate lymphoid stroma separate the cysts

and rarely in accessory salivary glands reported by Godwin[8] may be inflammatory or neoplastic in character. The histological findings suggest neoplasia of epithelial and lymphocytic cells, and although they show considerable variation in cellular pattern, some suggesting reticulum cell sarcoma, the lesions always are benign and are probably inflammatory in nature. They very likely are related to the Warthin's tumor and arise from the gland elements in lymphoid tissue demonstrated by Bryant and Thompson. The process is nodular and may be localized or diffuse and involve all or part of the gland. Complete local excision or irradiation have both provided control of these lesions.

■ *Malignant Epithelial Neoplasms*

CARCINOMAS—Squamous cell carcinoma is a stony hard tumor fixed to the overlying skin or mucosa or to the underlying structures. The borders usually are indistinct and there may be evidence of lymph node involvement. In a large number of instances, facial nerve paralysis is present.

The histological features of the neoplasm are those of squamous cell carcinoma elsewhere but with a lower level of differentiation. The origin of the neoplasm appears to be from metaplastic ductal epithelium which is commonly seen in mixed tumors and in mucoepidermoid tumors. The neoplastic changes, however, occur in the squamous cells without other epithelial components being represented (Fig. 10).

The neoplasms are aggressive and show extensive local invasion and lymph node involvement even though the history indicates short duration. In some instances the neoplasm has extended beyond the limits of eradication at the time the patient comes for treatment. The patients usually are over 50 years of age. In Buxton, Maxwell, and French's series of 11 patients, nine were over 50 years of age and one was 26. In Foote and Frazell's series the majority of patients were over

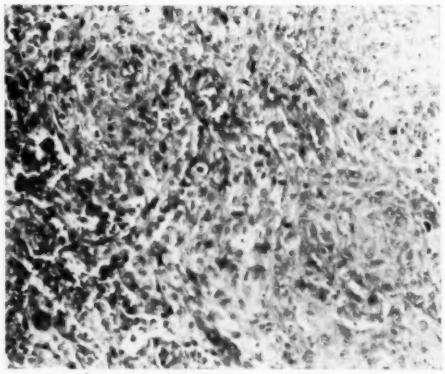

Fig. 10—Squamous cell carcinoma. Poorly differentiated squamatoid cells in medullary pattern. Little tendency for cornification

50; the youngest was 20. Buxton and his co-workers reported only two patients alive and free of tumor—one after two years and one after 16 years. The other nine were either dead, or alive with neoplasm. Among Foote and Frazell's patients followed for five years, four of 16 with parotid tumors were alive and free of neoplasm, and only one of ten having submaxillary gland tumors were alive and free of tumor. Wide excision of the tumor including the facial nerve appears to offer the best results in the treatment of this highly malignant neoplasm.

■ *Lymphoepithelioma*

Lymphoepitheliomas of the salivary glands are considered as poorly differentiated squamous cell carcinomas in the presence of lymphocytes. They may be the malignant counterpart of the benign lymphoepithelioma. They are highly invasive lesions of short duration (less than one year) occurring in patients over 55 years of age. Buxton, Maxwell, and French report five instances where, in spite of wide excision, radical lymph node resection (three patients) and postoperative irradiation, all patients were dead within one year. Because of the poor results achieved with surgery in these few instances, perhaps treatment should be by irradiation if biopsy verifies the lesion to be of this type.

■ *Gland Cell Carcinoma*

The neoplasms of gland cell character present a varied histological pattern and are described under the variety of terms such as adenoma, adenocystic carcinoma, pseudoadenomatous basal cell carcinoma, and cylindroma. These tumors are very common in the lesser salivary glands, especially those of the palate. Because of my experience with these tumors, I prefer to use the terminology and classification of Buxton, Maxwell, and French —pseudoadenomatous basal cell carcinoma (adenoid cystic, adenocarcinoma).

This tumor occurs in the parotid gland (Fig. 11-13) and submaxillary as well as mucous glands elsewhere, in the skin, breast, and lacrimal glands. It is composed of small cells with scant basophilic cytoplasm and relatively large hyperchromatic nuclei which grow in strands and cords and masses simulating a glandular pattern. The epithelial cords surround cellular regions containing tissue fluid, mucin, or hyalin. These tumors, having a predominance of stromal elements surrounded by delicate cords of epithelial cells, are designated cylindromatous, whereas those having a more medullary pattern are called canalicular. Foote and Frazell indicate that the histological pattern does not show the degree

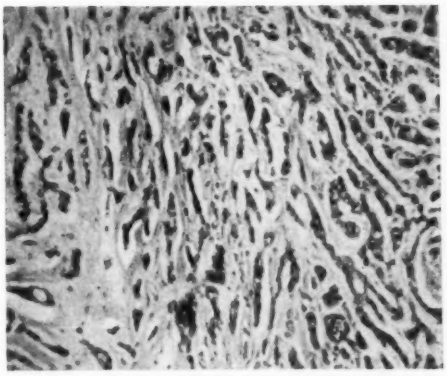

Fig. 11—Pseudoadenomatous basal cell carcinoma, cylindromatous type. Delicate cords of epithelial cells of small size separated by abundant mature stroma

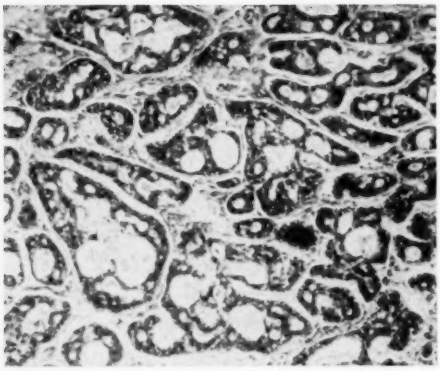

Fig. 12—Pseudoadenomatous basal cell carcinoma, canalicular type. Medullary nests of small hyperchromatic cells with central areas of liquefaction which produce a pseudoglandular appearance

of malignancy. Buxton, Maxwell, and French indicate that the cellular canalicular variant is the most malignant, and therefore careful naming of the tumor is important for treatment and prognosis.

The natural history of the tumor indicates the low degree of malignancy in this group of tumors. Most reports indicate that 25 per cent of the patients are free from tumor after five years. In Foote and Frazell's series the parotid tumors occur in both sexes equally, whereas with tumors of the submaxillary and accessory glands, two thirds of them appear in females. In the Buxton, Maxwell, and French series, the age distribution was between 21 and 27 and 15 patients were women. The discrepancy in statistics probably indicates that neither series was large enough to be meaningful. The range of age is wide with the average age being about 50. The tumor is slow growing in most instances with a history of the tumor having been present from 1 to 20 years. Pain is a frequent symptom, probably because of the tendency this tumor has for perineural extension (Fig. 14). Quattlebaum, Dockerty, and Mayo[9] reported perineural involvement in 11 of 21 patients. Buxton, Maxwell, and French reported pain as a prominent feature in 10 of 18 patients, 4 with facial paralysis.

These tumors have a noticeable tendency to recurrence even though grossly they appear to be well circumscribed or encapsulated. They may recur even though the local excision appears to be more than adequate. These tumors usually are not rapidly fatal, and metastasis occurs after multiple local recurrences. In the 18 cases reported by Buxton, Maxwell, and French none of the patients demonstrated cervical lymph node metastasis, whereas Foote and Frazell reported lymph node metastasis in 30 per cent of their patients. Kirklin and co-workers[10] reported cervical metastasis in 23.6 per cent of their pa-

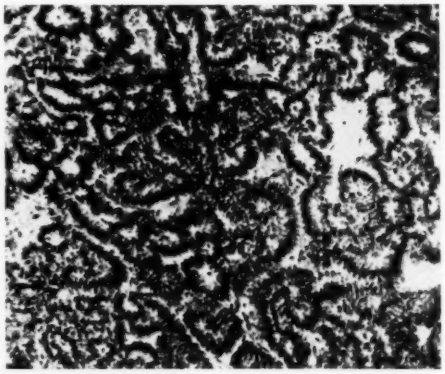

Fig. 13—Gland cell carcinoma. Although this is a variant of pseudoadenomatous basal cell carcinoma, it is often designated as adenocarcinoma. Small hyperchromatic cells arranged in pattern suggesting acini. Medullary cords are separated by delicate stroma

tients. Pulmonary metastasis is a common occurrence indicating the tendency to hematogenous spread. These findings would indicate that with repeated recurrence, cervical lymph node dissection and removal of the jugular vein should be advised.

This tumor has shown some degree of radiosensitivity, and perhaps postoperative irradiation should be advised, although experience is inadequate for positive evidence of its effectiveness in preventing recurrence or metastasis.

■ *Acidophilic Gland Cell Carcinoma*

Acidophilic gland cell carcinoma occurs less frequently than the squamous or pseudoadenomatous basal cell carcinoma. It is composed of large cells with abundant eosinophilic cytoplasm. The cells grow in medullary masses with little tendency to be arranged in cords or glandlike pattern. They show varying degrees of vacuolation. The epithelium may produce a desmoplastic reaction in the stroma.

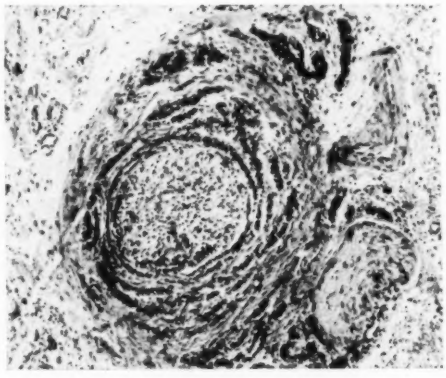

Fig. 14—Perineural extension of cylindromatous type pseudoadenomatous basal cell carcinoma

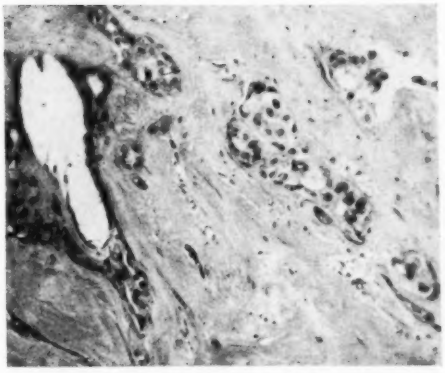

Fig. 15—Acidophilic cell carcinoma. Small nests and cords of plump eosinophilic cells in dense collagenous stroma

The acidophilic gland cell carcinoma, like the benign counterpart, the acidophil adenoma, occurs in patients over 50 years of age. The history usually reveals that the tumor has been present less than one year and pain is a frequent symptom. Extension is by regional lymph nodes. Buxton, Maxwell, and French suggest that wide local excision including the facial nerve and regional lymph node resection is the treatment of choice (Fig. 15).

■ *Serous Cell Carcinoma*

Serous cell carcinoma is another of the rare types of salivary gland neoplasms. It is composed of large cells having a granular basophilic cytoplasm with the cells in a glandular pattern. The cells do not exhibit pleomorphism, division figures are rare, and the usual criteria for malignancy are poorly demonstrated. In spite of the absence of conspicuous malignant morphology, the neoplasm behaves as a malignant variant of the serous cell adenoma (Fig. 16).

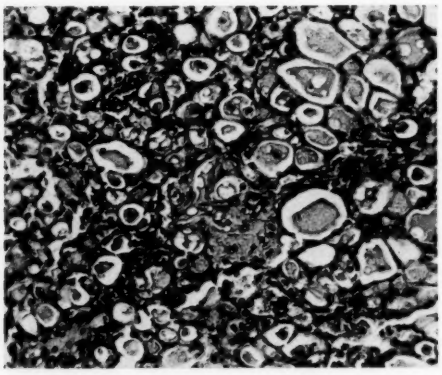

Fig. 16—Serous cell carcinoma. Numerous acinar-like spaces separated by cells with large hyperchromatic nuclei. Spaces contain bluish granular debris

Buxton, Maxwell, and French reported five instances, all in women over 50 years of age. The tumor grew slowly for several years. Pain was a prominent symptom in four patients. After treatment one patient was alive three years after radical excision with recurrent neoplasm. The other four died with carcinoma. Hematogenous metastasis is frequent as indicated by three patients having neoplasm in lung, abdomen, pelvis, rib, and brain. Wide excision at an early date appears to be necessary if there is to be any possibility of cure.

■ *Summary*

The benign mixed salivary gland tumors appear to have a good prognosis with wide local excision and preservation of the facial nerve. Although the tumor presents a wide variation in histological characteristics, the benign tumor can be recognized from the histological changes demonstrated in the tissue.

The malignant salivary gland tumors should have wide excision with sacrifice of the facial nerve, and in types which have a tendency for metastasis to regional lymph nodes, a radical neck gland dissection should be advised. Irradiation does not appear to be of value except for the malignant lymphoepithelioma and as a postoperative procedure in instances of pseudoadenomatous basal cell carcinoma.

Because of the difference in approach with each type of salivary gland neoplasm, it appears that biopsy or frozen section examination would be desirable to direct treatment and improve prognosis.

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The mucus retention phenomenon

■ *Samuel M. Standish,* D.D.S., M.S.,*
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In a review of 97 cases of mucocele, the vast majority had a condensed connective tissue wall without evidence of an epithelial cell lining. This observation suggested that the mucus retention cyst develops as a result of the escape of mucus through a ruptured duct into the adjacent connective tissue.

Recent studies of both human and experimental animal material have cast further doubt on the once commonly accepted idea that the mucocele (mucus retention cyst, retention phenomenon) is a true cyst, lined by duct epithelium and caused by duct obstruction. Bhaskar and co-workers[1] failed to demonstrate an epithelium-lined lumen in any of their 19 instances of mucoceles. Møller,[2] in a report of 44 clinical mucoceles, found an epithelial lining in only 1 of 19 specimens which were examined histologically. By way of confirmation, Bhaskar and co-workers[3] were able to produce lesions in rats and mice histologically identical with mucoceles by severing the salivary ducts of the submaxillary glands and allowing the mucous secretion to escape into the surrounding connective tissue. On the other hand, ligation of the major salivary gland ducts in rats and mice failed to produce mucoceles in investigations by Bhaskar and co-workers[3] and Standish and Shafer.[4]

With the exceptions of the studies of Møller, and those by Bhaskar and co-workers, only sporadic reports of one to three cases of mucoceles are found in the literature. For this reason, this series of 97 cases is reported to demonstrate certain important aspects of the mucus retention phenomenon as regards incidence, sites of occurrence, age predilection and histopathologic features.

■ *Materials and Methods*

The retention phenomena reported in this series represent routine biopsy specimens taken from the files of the department of oral pathology, Indiana University School of Dentistry, during the period July 1951 to November 1958.

All histologic sections were reviewed and the diagnosis was confirmed. In addition to the 97 cases histologically confirmed, an additional 14 cases involved lesions diagnosed as being histologically compatible with a mucus retention phenomenon although they did not show evidence of mucous pooling in the connective tissue. These latter cases are not included in this study. Available histories were recorded with regard to sex, age and race of the patient, location of the lesion and

Table 1

Incidence of mucus retention phenomena by age and sex*

Age range	Males	Females	Total no.	% of total
0–10 years	8	3	11	12
11–20	7	10	17	18
21–30	5	10	15	16
31–40	10	6	16	17
41–50	5	9	14	15
51–60	7	4	11	11
61+	4	1	5	5
Age not recorded	2	4	6	6
Total	48	47	95	100%

*Neither age nor sex was recorded in two instances.

pertinent history. Lesions which were recurrent (4) were tabulated only once.

■ *Results*

The 97 cases reviewed in this series were distributed almost equally between the sexes, 48 of the lesions occurring in males and 47 in females while in 2 the sex was not given (Table 1). In the youngest patient, a white boy, the lesion was reported to have been present at birth and was surgically excised at two months of age. The oldest patient was an 80 year old white man.

These lesions occurred overwhelmingly in Caucasians (93), only 2 lesions being recorded in Negroes. The race was not recorded in two of the instances.

The retention phenomenon occurred most frequently in the lower lip (Table 2) and appeared clinically as a smooth, fluctuant swelling which varied from bluish or blue-green in color in the superficial lesion to normal color in the deeper lesions (Fig. 1). Surprisingly, no lesion was recorded from the upper lip.

The duration of these lesions before surgical removal was given in the histories of 55 cases (Table 3). The lesion of shortest duration appeared as a painless "blister" approximately 1.5 cm. in diameter in the floor of the mouth 2 days prior to removal. The majority of patients (80 per cent) sought treatment within 6

Table 2

Incidence of mucus retention phenomena by site and sex

Site	Male	Female	Sex not given	Total	
				No.	%
Lower lip	27	16	—	43	44
Buccal mucosa	7	7	1	15	16
Floor of mouth and ventral surface of tongue	3	11	1	15	16
Palate	3	4	—	7	7
Retromolar region	2	3	—	5	5
Location not given	6	5	1	12	12
Total	48	46	3	97	100

months of the onset of the usually painless swelling. Occasional patients (6) reported lesions present for 1 year (2 patients) and 2, 3, 4 and 5 years (1 patient each).

The clinical histories sometimes referred to these lesions as recurrent swellings (23 instances) of which 15 spontaneously opened and drained at varying intervals. Two patients reported that they had collapsed the swellings with needles or other instruments on numerous occasions, and one lesion had been incised by the patient's physician.

A relation of trauma to the development of the lesion was clearly apparent in 9 instances (11 per cent). Those histories which simply stated "history of trauma" or otherwise failed to relate the trauma to the appearance of the lesion were excluded. As expected, the lesions associated with trauma occurred predominantly (8) on the lower lip and followed biting of the lip in most instances. One eight year old boy reported burning the lip prior to the appearance of the lesion. A lesion present since birth in a two month old boy was presumed to be due to birth trauma and was included in this group. Another instance occurred after the extraction of lower teeth and possibly was due to pinching of the lower lip with the forceps.

Table 3 Duration of lesion

	No. of cases	% of cases
1 week or less	2	4
1 to 4 weeks	17	31
1 to 4 months	13	23
4 to 6 months	12	22
6 months to 1 year	5	9
1 to 2 years	2	4
2 to 5 years	4	7
Total	55	100

A lesion of the soft palate occurred in a 50 year old woman who stated that she had fallen on a stick at 11 months of age. Although the accident and the lesion were not considered to have a direct cause-and-effect relation, the incidence was of especial interest since several salivary gland tumors in this institution have been observed in patients giving a similar history.

■ *Histopathologic Findings*

Evaluation of the histologic material in this series of cases revealed considerable variation in microscopic features, although no clear sequential pattern of development could be established. Those specimens which had not been ruptured prior to fixation obviously presented the best specimens for study.

Retained mucus, considered to be an essential diagnostic feature of these lesions, either occurred in discrete pools or was distributed diffusely, dissecting bundles of collagen fibers for varying distances into the peripheral connective tissue (Fig. 2 and 3,a).

The "cyst" lining in 93 instances was composed of connective tissue varying from mature and condensed collagen fibers (Fig. 2) and fibrocytes to ragged, disorganized granulation tissue (Fig. 3,a). In certain instances, masses of granulation tissue appeared to be growing into the mucous pool from the periphery, thus seemingly representing an attempt at repair. Inflammatory cell infiltration varied from none to moderate and often appeared related to the clinical history of trauma, incision or spontaneous rupture. Occasional lesions (6) demonstrated a partial or complete lining of cuboidal epithelium of obvious ductal origin which often could

be traced to a peripheral duct opening into the mucous pool. In 4 instances these lining cells were remarkably similar to oncocytes and occurred in patients aged 35, 54 and 80 years (Fig. 3,b and 4,b). The age of the fourth patient was not stated.

In addition, certain sections were noted which showed a mucus-filled, dilated duct sectioned tangentially and occasionally lying adjacent to the pool (Fig. 4,b). For this reason, those specimens showing a complete epithelium lining were recut semiserially in an effort to demonstrate an adjacent mucous pool if none was present in the initial section. The possibility that these epithelium-lined cysts were fortuitous sections either deep or superficial to the escaped mucus was therefore entertained in such instances. These lesions were generally composed of normal duct epithelium in contrast to the oncocyte lining noted in the majority of the epithelium-lined lesions.

A further observation noted in 17 lesions with discrete mucous pools which were not epithelium lined was the presence of foci of squamous epithelial cells seemingly floating free in the pool or associated with the granulation tissue wall. The pattern of cells could in no sense be construed as a partial cyst lining. A relation to ducts entering the mucous pool often could be demonstrated clearly (Fig. 4,a). The remainder of these clumps also were thought to be remnants of the origi-

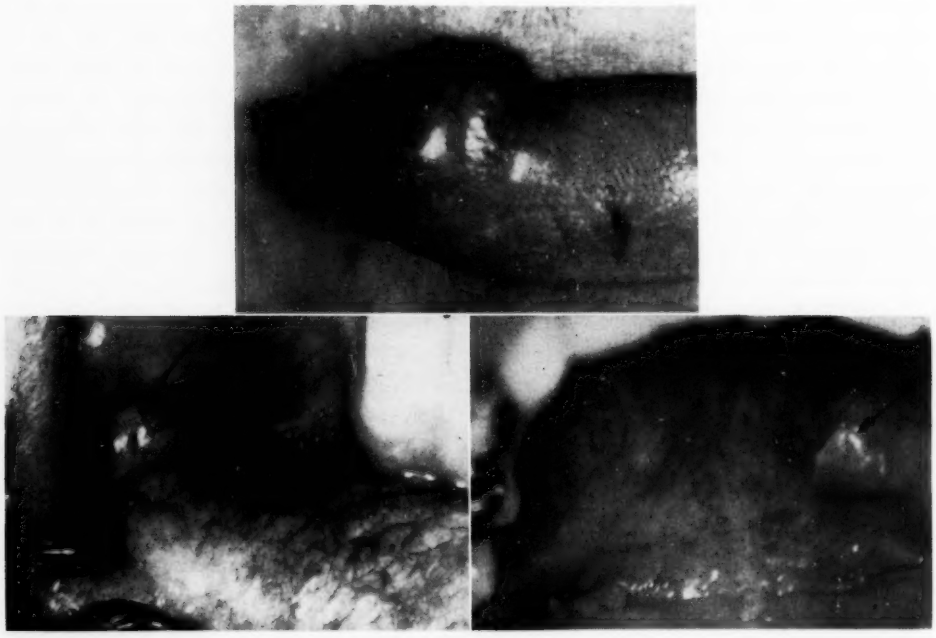

Fig. 1—Mucus retention phenomena. Above: On lower lip with lip everted. Below left: On buccal mucosa. Below right: At junction of hard and soft palates

nal duct but simply cut at right angles to the feeder duct.

Salivary gland tissues, when included in the specimen (66 instances), were studied for type, duct blockage effect and inflammation. As expected, the majority of glands were of the mucous variety (46) and a lesser number (20) represented mixed glands, predominantly mucous. Characteristic duct blockage effect, that is, atrophy of acinar elements and increase of duct structures, was seen in 11 instances and then only in tiny lobules of the gland. Focal concentrations of lymphocytes suggestive of adenitis were noted in 8 instances.

The overlying epithelium was characteristically thinned out in those lesions with mucous pools located superficially. In one instance there was invagination and migration of a strand of surface epithelium alongside and under a discrete superficial lesion.

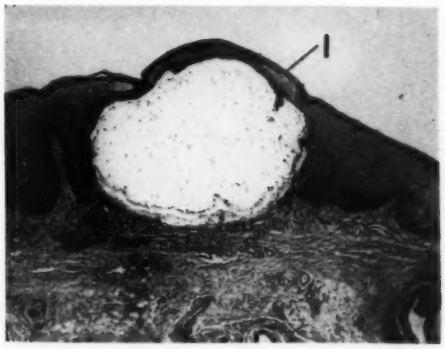

Fig. 2—Discrete lesion showing thinning of overlying epithelium (1)

■ *Discussion*

The mucocele is a relatively common lesion with no sex or age predilection in this series of cases and occurred most frequently on the lower lip. It occurred with lesser frequency on the buccal mucosa, palate, floor of the mouth, retromolar region and presumably wherever mucous glands are found. The fact that in this series no lesion occurred on the upper lip is noteworthy. The preponderance of these lesions in the white race is not understood.

In a discussion of ranulas, Brunner[5] pointed out that the sublingual gland and the glands of Blandin and Nuhn are chiefly of the mucous type, and frequently the site of mucocele formation, whereas the predominantly serous submaxillary gland is only rarely affected. A definite relationship to mucous glands was noted in this study.

The proposal by Bailey[6] and Brunner[5] that the simple ranula represents myxomatous degeneration of a mucous gland is not supported by the findings in this study. In fact, occasional sections were observed with mucous pools descending between the lobules of the gland without accompanying degeneration or evidence of pressure atrophy.

Associated gland changes were the exception and consisted only of moderate chronic inflammatory cell infiltration or small foci showing features of duct ligation in certain of the lesions. The relative lack of parenchymal change in these lesions is thus further evidence that secretory activity of the gland is not significantly altered since the saliva finds a ready egress into the connective tissue spaces. Although this might logically result in a slightly elevated back pressure of saliva, it cannot be construed as an acute blockage, since those changes associated with

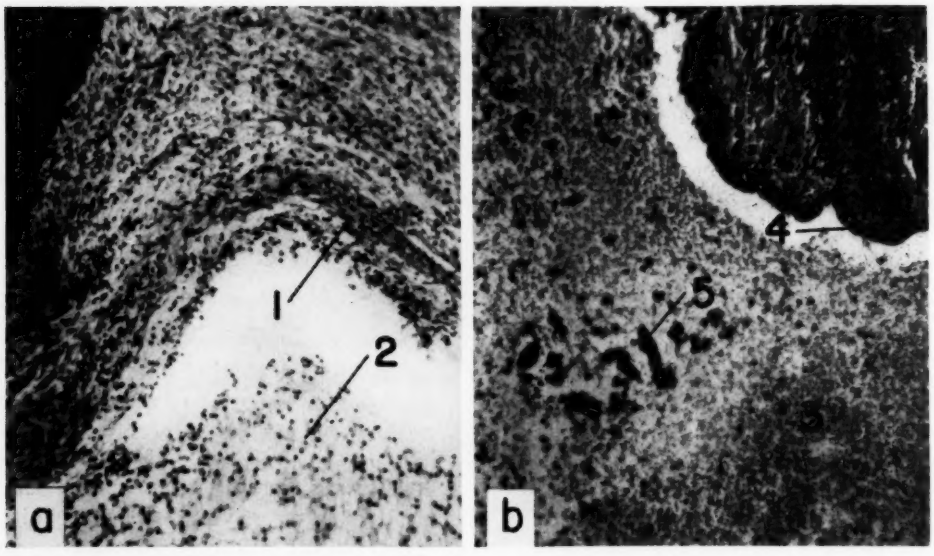

Fig. 3—Mucus retention phenomenon. a, high power view illustrates granulation tissue wall (1) adjacent to mucous pool (2). Collagen fibers of "cyst" wall show minimal condensation. b, view shows retained mucus (3) with lining oncocytes (4). Desquamated oncocytes (5) may be noted floating in mucous pool

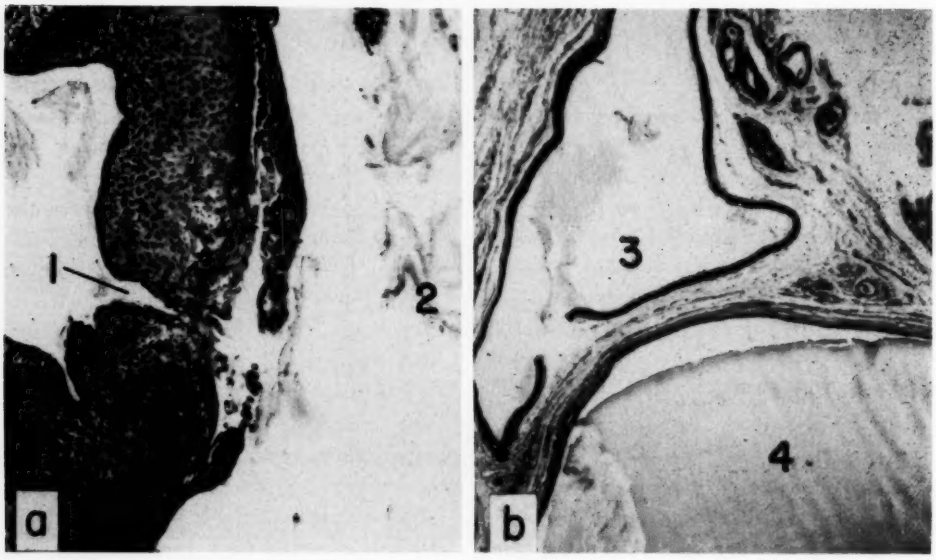

Fig. 4—Mucus retention phenomenon. a, high power view illustrates feeder duct (1) entering large mucous pool (2). b, view shows dilated duct (3) adjacent to large pool of mucus (4)

this phenomenon were not present.

Goodsell,[7] Ludwig,[8] Nathanson and Quinn,[9] Thoma,[10] Hurt[11] and Hippel[12] have reported that mucous cysts are lined by epithelium, although Goodsell's case probably represents a dermoid cyst. Møller[2] found an epithelial lining in 1 of 19 instances in which histologic examination was made. A case reported by the New York Institute of Clinical Oral Pathology[13] suggested that mucous cysts are lined by epithelium which subsequently degenerates, a concept with which Bernier[14] apparently concurred in principle. In the four cases with oncocyte-type epithelium linings reported here, the epithelium produced a complete or partial lining of the granulation tissue with relatively little desquamation. Those specimens with discrete mucous pools often had a condensed connective tissue lining which might, on occasion, be mistaken for a flattened epithelial lining. Bhaskar and co-workers[1] demonstrated argyrophilic fibers in this lining as confirmatory evidence of its connective tissue nature.

It has become increasingly clear that the vast majority of so-called mucus retention cysts represent an "escape" phenomenon in which a ruptured duct allows the ready egress of mucus into the adjacent connective tissue. However, two additional and perhaps distinct but still related processes may be noted occasionally in these lesions. One, representing a partial "retention" phenomenon, is seen as a dilatation of the excretory duct and smaller lobular ducts (analogous to the hydronephrosis seen in partial blockage of a ureter) with concomitant rupture and escape of mucus in the surrounding tissue. The third form, also representing a partial retention phenomenon, appears as a cyst lined by oncocytes and may represent a situation analogous to an "aneurysm" of a partially occluded duct. Although some of the reported cases of epithelium-lined mucoceles fall into the last two categories, the majority represent an "escape" phenomenon in which the cystlike space is lined by condensed connective tissue which has been erroneously interpreted as epithelium.

■ *Conclusions and Summary*

1. A series of 97 cases of mucus retention phenomenon has been reported.

2. The majority of these lesions were located on the lower lip but occurred with lesser frequency on the buccal mucosa, palate, floor of the mouth, retromolar regions and other miscellaneous locations. No lesions occurred in the upper lip in this series.

3. No sex difference in frequency of occurrence was found, and the lesions occurred only rarely in Negroes.

4. The retention phenomenon usually appeared histologically as either discrete or diffuse mucous pools surrounded by a layer of condensed connective tissue or granulation tissue.

5. Epithelium, when present, often could be associated with proliferative activity of the feeder duct leading into the mucous pool or remnants of the original duct. Those lesions appearing as "cysts" lined by normal ductal epithelium actually may represent a partial retention phenomenon manifest as ductal dilatation. Further sectioning may reveal the associated mucous pool.

6. The failure to find a duct ligation effect in the associated gland tissue is con-

sidered to be indirect evidence that the mucus retention phenomenon is a result of the escape of mucus into the adjacent connective tissue and not due to acute duct blockage.

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Long-range postoperative evaluation of transplanted hamster second molars

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Some instances of completely successful homogenous transplants were achieved in Syrian hamsters and no evidences of tissue incompatibility were demonstrated.

It is now generally accepted that under proper conditions soft tissues and bone will survive autogenous transplantation. Homogenous transplantation seems to be a more difficult procedure. Even in autogenous transplantation the survival of the original tissues is sometimes doubtful. The gradual replacement by new tissue, however, seems to occur definitely in heterogenous transplantation.

Since the widespread use of antibiotics, interest has been revived in the possibility of transplanting teeth. In this instance, however, success must involve the retention at least of the original root dentin. Otherwise the tooth would fall out of its socket. In 1954[1] an article from the laboratory at the University of Kansas City School of Dentistry showed that this was possible with replantation of hamster second molars. It was also shown that not only could the root dentin persist but there could be a regrowth of periodontal membrane, epithelial attachment, and

pulp. Later, a technic was developed whereby homogenous transplantation of hamster second molars was possible.[2] The results in both these instances were evaluated after a relatively short postoperative period, 30 days. Since there is a tendency for transplanted tissues in general to be replaced gradually and since dental clinicians often observe gradual root resorption after operative procedures such as in endodontics, it was felt that some longer range evaluations would be informative.

■ *Review of the Literature*

Tooth transplantation is not a new idea, and the literature abounds with case reports. However, only those more recent articles which include a reasonably extended postoperative observation period or which indicate something concerning the fate of homogenous transplanted teeth will be mentioned here.

Apfel[3] stated in 1950 that third molar tooth bud autogenous transplantation was a rather common procedure. In this article he reported on his first experiments in 1946 in which unerupted third molar tooth buds were enucleated from their bony crypts and transplanted into the first molar sites. He said that the teeth were still functioning and had good color. No dental caries was present, and the teeth were vital. Because the work was done with human beings, no histological data are available.

In 1954 Apfel[4] summarized his results up to that time. He showed roentgenograms of individual instances of third molar autogenous transplants to first molar sites that had survived from two to six years. The statement was made that over a hundred similar surgical procedures had been performed, but the number of complete successes was not indicated.

As part of a symposium,[5] Miller reported ten cases in which the developing third molar was transferred into a prepared first molar socket. These revealed a preponderance of success clinically. He stated that some replanted teeth have been reported to have functioned over 30 years, whereas the roots of others disintegrated within five years. Several other articles by other authors in this symposium reported essentially the same type of results. Collings[6] and Noble[7] have reported cases in other articles.

A variation in the site chosen for autogenous transplantation was recently reported by Villaseca H.[8] Good results were observed clinically nine months after a cuspid was transplanted to the first bicuspid site.

Fong and Agnew[9] reported four monkey experiments, which consisted of autogenous transplantation of the unerupted third molar to the first molar site. Since an experimental animal was used, it was possible to include histological studies. The most recent report shows some regeneration and replacement of tissue giving a rather favorable appearance at four days and four weeks. The specimens at four month and two year postoperative periods showed features such as ankylosis, osteodentin and some root resorption, which produced a much less favorable result. Fong and Agnew stated that the difference in the size of the teeth in the two species was probably the greatest contributing factor to the poorer result in the monkey as compared to man in autogenous transplantation of the third

molar to the first molar site. The fact that the first and third molars are essentially the same size in man, whereas the third molar is considerably larger than the first molar in the monkey, necessitated the extraction of both the second premolar and first molar in the monkey, thus producing excess space and greater mobility for the transplant.

Some reports also exist concerning homogenous tooth transplants. Apfel[4] stated that six transplants were accomplished, all resulting in failure. Shapiro and MacLean[10] stated that Lapchinsky and Malinovsky were reported to have transplanted tooth germs from young puppies into alveolar sockets of adult dogs with complete development in their new position. Similar successful results were also said to have been obtained if the donor was sacrificed on the day before the operation and the jaws kept overnight in the refrigerator. Shapiro and MacLean[10] used cats for transplanting cuspids in a similar manner. The transplants persisted for two years without evidence of resorption, but failed to erupt into the oral cavity. An abstract[11] of a histological study of this material indicated that the tooth germs developed additionally after transplantation into the host if no injury or infection occurred.

Fleming[12] reported that human tooth germs survived when transplanted in the eye and axilla of lower animals. However, Herschfus[13] was completely unsuccessful in homogenous tooth bud experiments in dogs.

■ *Materials and Methods*

Littermate Syrian hamsters, 30 days old, were used for these experiments. After being anesthetized intraperitoneally with pentobarbital sodium, paired animals received bilateral exchange of second mandibular molars. The teeth were kept in sterile physiologic saline solution during interoperative procedures. The animals were awake approximately 30 minutes after surgery. Usually food was withheld until the following morning, when regular laboratory chow, green vegetables, and water were offered.

After a 30 day postoperative period, ten animals were sacrificed, the mandibles removed and placed in 10 per cent Formalin. In this group, food was withheld for three days immediately after the surgical procedure.

The next group of 14 animals was allowed to live 60 days after the surgical procedure, and the remaining 17 were sacrificed after 18 months. No specific postoperative precautions were observed.

The fixed tissues were decalcified electrolytically, dehydrated and embedded in paraffin. Ten-micron sections were cut, and every tenth section was mounted and stained with hematoxylin and eosin. These were evaluated microscopically.

Evaluations of success or failure were based on viability of the pulp, presence or absence of inflammation, condition of the periodontal membrane, and ability of the surface epithelium to attach at the cervical portion of the tooth. The transplants shown in Figures 1-4 were considered to be successful, and those in Figures 5 and 6 were considered unsuccessful.

■ *Results*

Of 20 transplants from the animals sacrificed 30 days postoperatively, 25 per

Fig. 1—Successful transplants from group sacrificed after 18 months. Root resorption is not evident. Periodontal membrane shows complete reattachment, and normal pulp extends to tip of pulpal horns. Epithelial attachment is slightly low in interradicular region; otherwise it is attached at normal cervical region

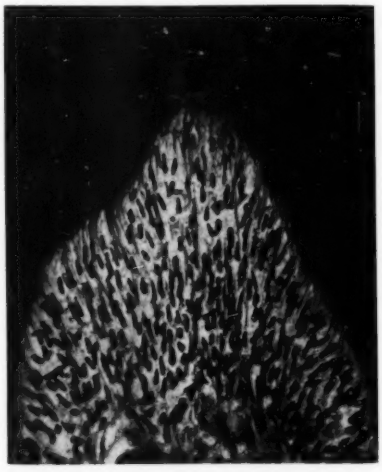

Fig. 2—Higher magnification of pulpal horn shown inside box in Figure 1. Note odontoblasts with their odontoblastic processes extending into dentin

Fig. 3—Successful transplant from group sacrificed after 18 months. There is good periodontal membrane attachment and epithelial attachment in cervical region; root resorption is not excessive. Pulp is viable into pulpal horns, but there are no odontoblasts. Some osteodentin is present

Fig. 4—Successful transplant from group sacrificed after 60 days. There are good periodontal membrane and epithelial attachments. Although pulp is viable, pulp chamber is almost completely filled with dense sclerotic-type bone with bone marrow

cent were successful. There were 28 transplants evaluated in the series sacrificed 60 days postoperatively; of these, 57 per cent were successful. Of the 33 transplants evaluated 18 months postoperatively, 21 per cent were successful. Eight of the 33 teeth were missing entirely. Four of the animals sacrificed 60 days postoperatively gave histologic evidence of actinomycosis. Of the successful transplants in the group sacrificed 18 months postoperatively, however, three were perfect and one nearly perfect. In the light of these factors it is doubtful whether there was much significant difference in the results in the transplants from any of the three groups of animals.

In general the condition of the various tissue components was about the same as that seen in replantation studies. In some animals the pulp had completely regenerated. As nearly as can be ascertained, in these instances the odontoblasts lie dormant until granulation tissue, migrating up the root canal, re-establishes a nutrient supply from the capillaries. Good pulp regrowth seems to be less frequent than good regrowth of the other tissue components.

In the specimens with less regrowth, various conditions were seen. In some the pulp was acellular, others showed some inflammation, whereas still others showed some osteodentin. There was no discernible difference in the three groups of animals in this respect.

The periodontal membrane seemed to form easily and showed good anchorage to the bone and cementum. The only exceptions to this condition were in the regions where inflammation or other pathological conditions were evident. No evidence of coliagenous fiber formation parallel to the root surface was seen.

The epithelial attachment was frequently seen at the normal cervical line, but areas of migration forming some periodontal pockets were found. This was prevalent with no more frequency in any one group than in any other.

Although some root resorption was evident in all three groups, in the successful transplants it was minimal in amount and the periodontal membrane was attached in the Howship's lacunae. When it was excessive, it was associated with inflammation in the surrounding tissues.

When inflammatory cells were seen inside the pulp, it was difficult to tell whether the inflammation was associated with normal granulation tissue or whether it was in the process of abscess formation. In the tissues surrounding the root of the tooth, when the inflammation was found it probably was not a part of the normal granulation tissue. It was felt that this inflammation was somewhat more pronounced in the group sacrificed 60 days postoperatively, and when present, frequently excessive in the group sacrificed 18 months postoperatively. This manifested itself as a frank osteomyelitis and liquefactive necrosis. Since actinomycotic lesions could be identified in some instances, chronic infection was always a distinct possibility, and the longer the time between the surgical procedure and sacrifice, the more time allowed for extensive destruction to occur.

Ankylosis was not an impressive feature in any of the animals. An occasional small spur of bone could be seen touching the teeth, but this was seen no more fre-

quently in the transplanted second molars than in the undisturbed first molars.

■ *Discussion*

It is evident from the literature review that there are still differences of opinion concerning the successfulness of tooth transplantation. Most of the articles are concerned with the autogenous transplantation of third molar tooth buds into the first molar site. The authors of the clinical reports usually feel their cases are successful. However, the inherent poor root growth of the third molar and the lack of surety that there will be sufficient growth to bring the tooth into good occlusion, present less than ideal conditions.

In Fong and Agnew's monkey experiments, histological examination of material from animals sacrificed a relatively long time after tooth transplantation seems to show that little success has been achieved. The conclusion of these authors that the relatively poor success found in animals sacrificed two years after transplantation was due to poor technic could well be true. However, the question arises as to what the findings would be in long range clinical cases if it were possible to make histological studies. Certainly the majority of hamster experiments reported here as unsuccessful would have been judged successful if only macroscopic examinations had been employed.

Perhaps the problem can be evaluated better if the information derived from one isolated experiment is kept in mind as

Fig. 5—Unsuccessful transplant from group sacrificed after 60 days. There is good periodontal membrane attachment along interradicular surface of one root and epithelial migration to apex along interradicular surface of other root. Note area of inflammation around apex of one root. Pulp is completely necrotic with inflammation in lower part of root canals

Fig. 6—Unsuccessful transplant from group sacrificed after 60 days. Although good periodontal membrane attachment is present in some areas, there is extensive epithelial migration along one interradicular area. No evidence of pulp viability is present. Very intense inflammation can be noted periapically and in pulp root canals

opposed to that derived from a tabulation of success and failure of a number of experiments. A completely successful isolated case can indicate the degree of regrowth potential inherent in the tissues involved.

In the 1954 article from the laboratory at the University of Kansas City,[1] one tooth was shown which had achieved complete periodontal membrane regrowth, perfect epithelial attachment at the cervical line and normal pulp with odontoblasts. There were no pathological features such as root resorption, ankylosis, osteodentin, or inflammation. A like case can be cited in the group sacrificed 18 months postoperatively in the present study (Fig. 1).

These isolated cases provide ample proof that the regrowth mechanism potential in these tissues is perfect, in contrast to nerve cells, in which the regeneration potential is zero. Hence, it is evident that present technics are such that this regrowth potential can be fully expressed and perfect results obtained. How frequently present technics such as those of Apfel[4] and Hale,[14] for clinical cases, or experimentally as in our laboratory, permit this potential to be fully expressed can be ascertained only from a quantitative percentage tabulation of all degrees of success and failure of a number of experiments.

In our earlier study reported in 1954, there were several cases with postoperative periods of less than 30 days in which it was felt that good results were being achieved. Granulation tissue had proceeded part way up the pulp canal; it was felt that it probably would have continued if the animal had not been sacrificed. Later, when adequate finances were secured which permitted an extensive number of experiments to be performed for quantitative tabulation, it became apparent that perfect results were not always achieved. The achievement of success in 25 to 58 per cent of the transplants, as reported in this article, certainly illustrates this point. These experiments were performed some two years ago. Currently much better results are being obtained, but perfection has not been reached.

The literature concerning the problem of homogenous and heterogenic tooth transplantation is much less abundant and the results confusing. Apfel's[4] report of homogenous human transplants is completely negative, but Fleming[12] reported some success even with heterogenic experiments when human tooth germs were transferred to laboratory animals. Certainly greater tissue incompatibility would be expected in the latter instances. Perhaps an evaluation after an extended postoperative period would clarify Fleming's results. Shapiro and MacLean[10] had some success with transplantation of tooth buds in cats and quoted a report that Lapchinsky and Malinovsky achieved success with tooth germs in dogs, but Herschfus' experiments in the same species were a complete failure. Of course tissue incompatibility is a real possibility and one species could exhibit this to a greater degree than another, but it is difficult to reconcile these divergent results on this basis. Differences in technic, age of the transplanted tooth or tooth germ and length of the postoperative period could all be factors.

The results reported in this paper, as well as the short-range evaluation reported

earlier, did not demonstrate tissue incompatibility. Caution should be observed in evaluations of tissue incompatibility, however. Inflammation from tissue incompatibility can be confused with that associated with infection or granulation tissue formation. When the work in this laboratory progresses to the point where perfect results always can be achieved in hamster tooth transplantation, then a definitive long-range experiment with homogenous transplants using the same technics, would be revealing.

■ *Comment*

The tissues associated with the tooth have a complete regrowth potential. Considerably more work is needed to analyze the factors involved whereby this potential invariably can be expressed fully. Perhaps means can be devised whereby this natural potential can be enhanced. Whether this potential will invariably be thwarted in homogenous and heterogenic procedures by tissue incompatibility is not known. Certainly the results in this report provide sufficient encouragement for additional study.

■ *Summary*

1. Individual instances of perfect regrowth of periodontal membrane, epithelial reattachment and viable pulp with odontoblasts were found in homogenous transplanted hamster molars 18 months postoperatively.

2. The percentage of successful transplants did not seem to be especially different after various postoperative periods.

3. No evidence of tissue incompatibility was demonstrated, although its absence was not demonstrated conclusively.

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Aneurysmal bone cyst and other giant cell lesions of the jaws: *report of 104 cases*

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The clinical and roentgenographic features, differential diagnosis, behavior pattern and the treatment of various types of giant cell lesions which involve the jaws are described. In this group belong the aneurysmal bone cyst, peripheral giant cell reparative granuloma, central giant cell reparative granuloma, and giant cell nodes. This study is based on 104 cases filed at the Armed Forces Institute of Pathology.

Though similar in many respects to the remainder of the skeleton, the maxilla and the mandible possess certain features which are unique to them. For example, phylogenetically they both represent secondary bones. The mandible develops through the participation of both endochondral and intramembranous bone formation and by the differentiation of the so-called secondary cartilages (condylar and coronoid). The presence in the bone marrow of both odontogenic and nonodontogenic epithelium, the existence of teeth and the centrally located blood supply are some of the other features which are peculiar to the jaws. The fact that these bones are the sites of a variety of cysts and tumors which are not seen elsewhere in the skeleton is therefore expected.

In addition to these diseases, however, there are other lesions which are not unique to the jaws but whose behavior in these sites is at a variance with that of identical lesions elsewhere in the body. For example, a giant cell lesion of the mandible is far less destructive than an identical lesion of the femur, and an oral papilloma has a much better prognosis than a similar lesion in the urinary bladder. Consequently, the treatment of jaw lesions must be predicated on an analysis of their behavior pattern in these bones specifically, rather than on their behavior in the skeleton as a whole.

In this report are described the clinical and roentgenographic features, differential diagnosis, behavior pattern and the treatment of various types of giant cell lesions which involve the jaws. To this group belong: (1) the aneurysmal bone cyst; (2) peripheral giant cell reparative granuloma; (3) central giant cell reparative granuloma and (4) the giant cell "node" of hyperparathyroidism. The purpose of this report is, first, to describe the aneurysmal bone cyst, the occurrence of

which, in facial bones, has been reported only once previously;[1] second, to re-emphasize the wide difference in the behavior of a giant cell lesion of the jaw as compared with a similar lesion in other portions of the skeleton, and third, to group together all the giant cell lesions of maxilla and mandible.

■ *Material*

This study is based on 104 cases filed at the Armed Forces Institute of Pathology under the diagnosis of giant cell reparative granuloma, giant cell tumor, giant cell epulis, giant cell lesion and aneurysmal bone cyst of the maxilla or mandible.

■ *Aneurysmal Bone Cyst*

Although first mentioned in 1942,[2] the aneurysmal bone cyst was established as a clinico-pathologic entity in 1950,[3,4] and to date less than 60 cases have been described in the literature.[1-5] However, prior to a recent report by us[1] on two instances of this lesion in the mandible, none of the facial bones were known to have been involved. The present study, which includes five instances of the aneurysmal bone cyst of the jaws, is the second report of this lesion in the facial bones. The clinical, roentgenographic and microscopic features of this lesion will be outlined.

CLINICAL FEATURES—The majority of patients in the present series were around 20 years of age or younger (Table 1). The lesion was of five weeks to six months in duration, and in two instances there was a history of local trauma. Four of the five lesions occurred in females and

Table 1 • Clinical features of five cases of aneurysmal bone cyst

Age, race sex	Duration	Jaw	Location	Roentgenographic findings	Clinical or gross features
9 W F	6 months	Mandible	Right first bicuspid to left second molar	Considerable radiolucency in area, extending from apexes of teeth to lower border of mandible	Migration and malocclusion, lower anterior teeth. Swelling of floor of mouth and submandibular area. Firm, nontender to palpation. Pt. fell from tricycle 2 yrs. previously and bumped her chin
11 W F	3 months	Mandible	From the angle to the condyle	Large multilocular cyst extending from angle to condyle. Size of an egg, expands ramus both laterally and medially	Swelling over right side of mandible which increased in size and became tender
7 C M	1 week	Mandible	Angle of mandible	Multilocular cystic lesion	Swelling of lower jaw. One week ago mother noticed "shortening" of teeth
22 W F	?	Maxilla	First to the third molar	Radiolucent area in maxillary molar region	On excision, gross tissue was red in color and contained numerous cysts 2-3 mm. in size
59 C F	5 weeks	Mandible	Right half of mandibular body	Radiolucent honeycombed area extending from angle and including most of right half of the body	The "tumor" mass appeared in the socket 5 weeks after extraction of second molar. The area was enlarged, hard but painless. Teeth on that side were extracted and area curetted.

Fig. 1—Aneurysmal bone cyst. Occlusal roentgenogram of maxilla in 22 year old woman which shows large area of radiolucency. Teeth are vital. AFIP Acc. 852133

Fig. 2—Aneurysmal bone cyst shown in Figure 1. Roentgenographic picture is not characteristic. But for its location, this lesion resembles a globulomaxillary cyst. AFIP Acc. 852133

the same number involved the mandible. Of the mandibular lesions, three involved the body and one the ramus. Clinically, there was a firm, bony enlargement of the involved site which was nontender to palpation. Except in one instance the mucosa covering the lesion was not ulcerated. The lesions were painless or were only slightly tender, and the patients sought attention because of the swelling, deformity, migration or "shortening" of teeth and malocclusion. The swelling and malocclusion became progressively worse. On exploration, the operator encountered a mass of soft reddish brown tissue which bled readily. Curettage of this tissue was associated with abundant hemorrhage which, however, was not too difficult to control. After removal of the lesion, gross sectioning revealed a variable number of small blood-containing cystic spaces in a mass of reddish brown tissue.

ROENTGENOGRAPHIC FEATURES—The roentgenograms showed areas of radiolucency which were usually extensive and in one instance had ill-defined borders. One of the lesions, but for its location, was almost identical to the globulomaxillary cyst (Fig. 1 and 2). In two instances fine bony septums in the radiolucency gave it a multilocular or honeycombed appearance (Fig. 3). The lesions did not perforate but destroyed and "expanded" the cortex. The roentgenographic appearance was not diagnostic and the diagnoses rendered by the clinician or the radiologist were osteomyelitis, cyst or ameloblastoma.

DIFFERENTIAL DIAGNOSIS—In a differential diagnosis of the roentgenographic picture such as that seen in the aneurysmal bone cyst, ameloblastoma, traumatic cyst, giant cell reparative granuloma and a follicular cyst must be considered. Ameloblastoma, however, usually occurs in an older age group (over 30 years). The traumatic cyst usually is characterized by a scalloped outline and does not have a "soap bubble" appearance, and in the follicular cyst either a regional tooth is missing or it is unerupted and involved in the cystic lesion. In a lesion such as that seen in Figure 3, however, where

there are a number of unerupted teeth, a distinction from the follicular cyst is impossible. A differential diagnosis between a giant cell reparative granuloma and an aneurysmal bone cyst, on the basis of clinical and roentgenographic findings alone, cannot be made.

MICROSCOPIC FEATURES—The microscopic features of the aneurysmal bone cyst are diagnostic. The cyst consists of numerous small and large pools of blood which are lined only by flattened spindle-shaped cells and multinucleated giant cells (Fig. 4). The stroma of the lesion is identical to that of the giant cell reparative granuloma; that is, it consists of giant cells, fibroblasts, capillaries, hemorrhage and hemosiderin (Fig. 5). Special stains reveal that the blood pools do not have elastic or smooth muscle in their walls and therefore do not represent blood vessels (Fig. 6).

TREATMENT—Aneurysmal bone cyst is treated best by local conservative curettage.

■ *Giant Cell Reparative Granuloma*

The giant cell reparative granulomas are of two types, the central (occurring within the jaws) and the peripheral (those involving the gingiva). Although histologically they resemble or are identical to the giant cell tumors of bone, in their clinical features and natural history they are dissimilar. It is estimated from the review of the literature[6-19] that about 400 cases of the giant cell reparative granuloma have been recorded. The present series of cases includes 65 peripheral and 34 central giant cell lesions. Tables 2 and 3 summarize the clinical and microscopic findings in these cases.

PERIPHERAL LESIONS—Clinically the peripheral giant cell lesion appeared as a pedunculated or broad-based growth of the mandibular or maxillary gingiva. Usually it was smooth surfaced, reddish blue in color, sometimes lobulated and bled easily. The lesion was limited to the gingiva or to the soft tissue of the edentulous ridges. As seen in Table 2, the vast majority occurred during the period of permanent dentition. In the present series the males were affected almost twice as frequently as females, and both jaws were equally involved. In one instance, the lesion had been present for seven years, but usually at the time of excision it had been present for a few weeks to a few months. Although histories were not complete, five lesions were reported to have

Fig. 3—Lateral roentgenographic view of aneurysmal bone cyst in ten year old white girl. Lesion is multilocular and has caused drifting of both erupted and unerupted teeth. Roentgenogram is not diagnostic. AFIP Acc. 735109

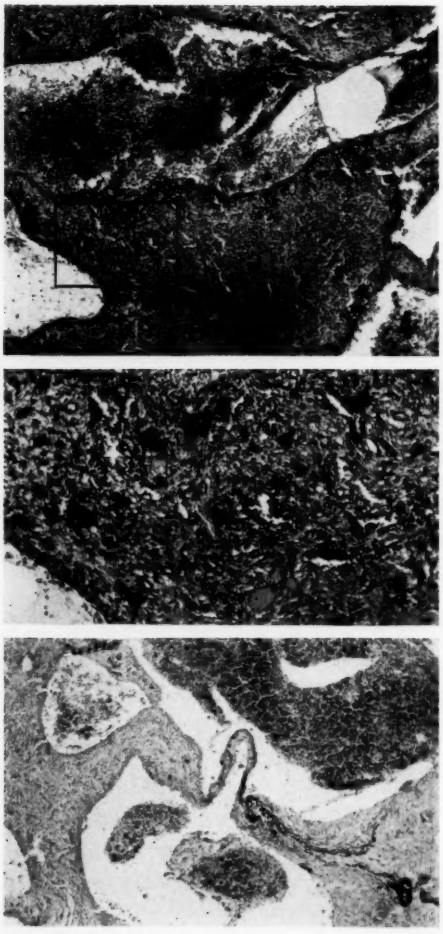

Fig. 4—Photomicrograph of aneurysmal bone cyst. Note blood containing spaces. AFIP Neg. 58-8508

Fig. 5—High-power photomicrograph of area shown in Figure 4 to illustrate stroma which is identical to that of giant cell reparative granuloma. AFIP Neg. 58-8509

Fig. 6—Aneurysmal bone cyst. Orcein stain to show absence of elastic tissue around blood pools. Black staining material in stroma is bone. AFIP Neg. 57-1040

followed tooth extraction and five were associated with ill-fitting dentures. In one instance the patient was pregnant.

DIFFERENTIAL DIAGNOSIS—The clinical picture of a slow-growing, pedunculated or broad-based, smooth surface or ulcerated, easily bleeding, bluish red lesion of the gingiva brings to mind a number of conditions, the most common of which are the pyogenic granuloma, pregnancy tumor, giant cell reparative granuloma, a peripheral fibroma and in rare instances a soft tissue plasma cell myeloma or plasmacytoma. For a differential diagnosis of these a biopsy is necessary.

ROENTGENOGRAPHIC FEATURES — Most of the peripheral lesions showed no abnormality in the roentgenograms. In three instances, however, the dentist reported that the bone immediately underlying the gingival growth appeared radiolucent.

MICROSCOPIC FEATURES—All peripheral giant cell lesions were characterized by giant cells, a dense background of young fibroblasts and numerous small blood vessels (Fig. 7). In addition to these features, hemosiderin in widely scattered areas was seen in 61 lesions (93 per cent) (Fig. 8), extravascular erythrocytes in 56 (86 per cent), phagocytosis in 33 (51 per cent), organization of hemorrhage in 4 and bone formation in 4. Twenty-seven lesions showed a connective tissue zone which separated the mucosal epithelium from the "tumor mass" and in nine instances the lesion was ulcerated. Two lesions showed a considerable degree of giant cell degeneration and in one of these considerable fibrosis had occurred.

Table 2

Peripheral giant cell reparative granuloma

Age incidence*		Sex	Location	Duration	Histologic features	
Years	No. of cases				Per cent	
1—10	5	Male—43	Mandible—32	1 week—7 years	Hemosiderin	93
11—20	9	Female—22	Maxilla —33		Extravascular erythrocytes	86
21—30	13				Phagocystosis	51
31—40	9				Ulceration	14.5
41—50	11				Organization of hemorrhage	6
51—60	7				Bone	6
61—70	2					
71—80	1					

*Clinical histories in eight cases did not give the patient's age.

Table 3

Central giant cell lesions

Age incidence		Sex	Location	Duration	Histologic features	
Years	No. of cases				Per cent	
1—10	6	Male—12	Mandible—22	3 weeks—3 years	Hemosiderin	100
11—20	14	Female—22	Maxilla —12		Extravascular erythrocytes	100
21—30	9				Phagocytosis	50
31—40	3				Organizing hemorrhage	30
41—50	1				Bone formation	25
51—60	1					

TREATMENT—After local removal, none in the present series of lesions is known to have recurred.

■ *Central Lesions*

Clinically, the central giant cell reparative granuloma is an endosteal lesion of the jaws. Some of the clinical features, as observed in 34 patients, are given in Table 3. The majority of these lesions occurred in patients under 25 years of age (74 per cent in the present series); the mandible was more frequently involved than the maxilla, and the lesion was about twice as common in the female as in the male. At the time of surgical removal, the lesion had been present for from three weeks to three years. In seven instances it followed tooth extraction and in one an impacted tooth was associated with it. The central giant cell reparative granuloma was either asymptomatic and discovered on routine examination, or it produced a local enlargement and deformity of the jaw which sometimes was accompanied by migration and loosening of teeth.

It is apparent from this description that the age incidence, location and sex susceptibility of the central giant cell reparative granuloma is identical to that of the aneurysmal bone cyst.

ROENTGENOGRAPHIC FEATURES—The roentgenograms showed radiolucent areas of varying size (Fig. 9-11). On occasion, thin septums of bone extended from the periphery into the center of the radiolucency and gave it a "soap bubble" appearance (Fig. 12). The radiolucencies often extended beyond the normal contours of

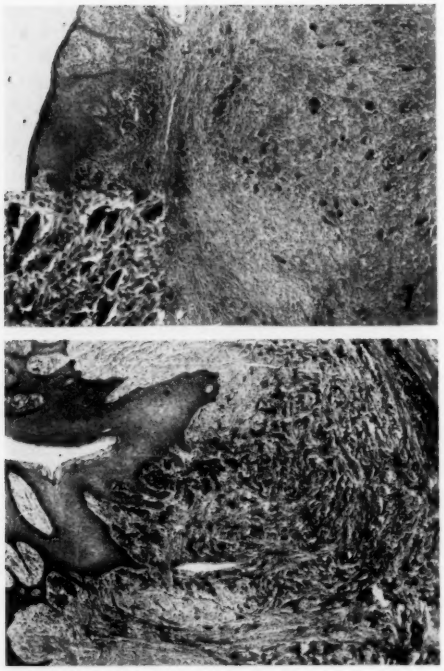

Fig. 7—Peripheral giant cell reparative granuloma. Insert shows giant cell. AFIP Neg. 57-6587. AFIP Neg. 58-8506

Fig. 8—Peripheral giant cell reparative granuloma showing large deposits of hemosiderin. AFIP Neg. 57-5689

the jaw and were limited by a thin shell of bone (Fig. 12). Complete destruction of bone around the lesion, however, was extremely rare. In some instances the movement of regional teeth and tooth germs was striking (Fig. 12).

DIFFERENTIAL DIAGNOSIS—The roentgenographic appearance of the central giant cell reparative granuloma is very similar to that of a number of other intrabony lesions, prominent among which are the ameloblastoma, follicular cyst, radicular or residual cyst, aneurysmal bone cyst, and a "soft" or noncalcifying odontogenic tumor. The ameloblastoma, however, usually occurs at a later age in life; the follicular cyst is either associated with a missing tooth (primordial cyst), or the tooth is directly related to the cyst (dentigerous cyst) and the radicular cyst is associated with a nonvital tooth. It is of course evident that for a definitive diagnosis, a microscopic examination of the lesion is necessary.

MICROSCOPIC FEATURES—The histologic appearance of the central giant cell reparative granuloma was identical to that of the peripheral type, and but for the missing blood pools, it was indistinguishable from the aneurysmal bone cyst (Fig. 13). Hemosiderin and extravascular erythrocytes were seen in all instances. In 17 lesions (50 per cent), phagocytosis was evident and in 8 instances (25 per cent), newly formed bone trabeculae were seen within the mass of the lesion. In 10 lesions (30 per cent), there was evidence of organizing hemorrhage. This consisted of focal areas of extravascular blood in and around which hemosiderin and fibroblastic proliferation was seen. In six lesions which were removed *en bloc,* a thin peripheral layer of immature trabecular bone could be seen. In one instance the molar teeth were a part of the surgical specimen, and these showed resorption of roots by the giant cell lesion.

■ *Giant Cell Nodes, or Brown Nodes*

In hyperparathyroidism, the mandible or maxilla may be the sites of a giant cell lesion. In some instances the jaw

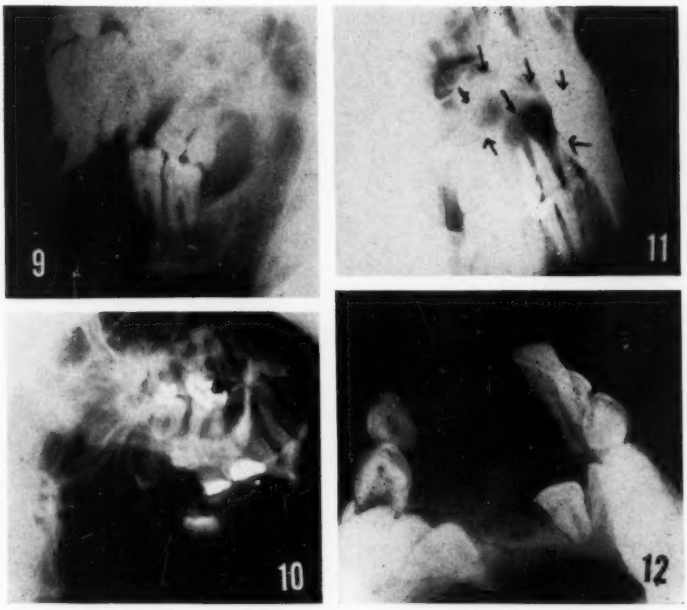

Fig. 9 to 12—Roentgenograms, all of which represent central giant cell reparative granuloma. The variety of roentgenographic appearances that this lesion may assume can be seen. AFIP Accs. 765149, 692783, 546719, and 503757

lesion may be the earliest clinical manifestation of the disease. In a series of 22 cases of hyperparathyroidism, Black and Ackerman[20] found seven instances where the first symptom was a tumor in the maxilla or the mandible. One of such instances, where the oral manifestations preceded any other lesions, and in the early diagnosis of which the oral surgeon played an important part, is described briefly.

■ *Report of Case*

A 27 year old white woman had a radiolucent lesion which extended from the right lateral incisor to the right first molar (Fig. 14 and 15). Clinically, the region was swollen, slightly painful and had been present for a year and a half. There was no history of trauma, but the four teeth in the region were nonvital. The entire lesion was excised and the pathologist rendered a diagnosis of giant cell tumor of the mandible. Five months later the patient returned with osteolytic lesions which involved the skull, ribs and left femur (Fig. 16 and 17). The blood calcium was elevated (14.5 mg.), phosphorus was slightly depressed (2.75 mg.) and alkaline phosphatase was considerably increased (18.7 Bodansky units). In other words, the blood chemistry was compatible with that seen in hyperparathyroidism. The patient was examined and a parathyroid adenoma was removed.

The histologic features of the jaw lesion were identical to those of the cen-

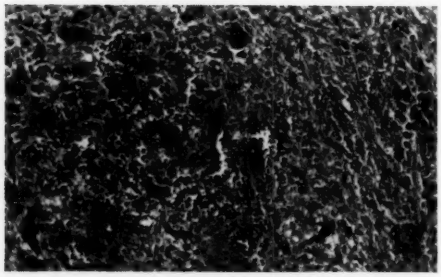

Fig. 13—Photomicrograph of central giant cell reparative granuloma. Histologic features are identical to those seen in peripheral lesion, as well as to the stroma of aneurysmal bone cyst. AFIP Acc. 652564

tral giant cell reparative granuloma.

The importance of this case report lies in the fact that it demonstrates how giant cell lesions of identical morphology may occur under widely diverse circumstances. In the event that a giant cell lesion of the jaws should recur after local curettage, the possibility of hyperparathyroidism, therefore, must be considered.

■ *Discussion*

HISTOGENESIS OF GIANT CELL LESIONS—The histogenesis of giant cell lesions, which has been a matter of much controversy, and the various theories regarding their origin, as well as the proponents of those views, are shown in Table 4. It appears, however, that the histologic features of all of these lesions are identical; the only exception is the aneurysmal bone cyst which, in addition to the other characteristics of the giant cell lesions, contains large blood-filled spaces. Although these large blood pools are seen only in the aneurysmal bone cyst, small foci of hemorrhage and extravascular erythrocytes are seen in a large majority of all types of giant cell lesions. Histogenetically, the most important feature of the giant cell lesions, as a group, is the presence of hemosiderin, hemorrhage, and an occasional focus where the organization of hemorrhage can be observed. Furthermore, hemosiderin, with the exception of the lesions under discussion, is not usually seen in any other central lesion of the jaws. Whereas this pigment may on occasion be found in a peripheral gingival lesion such as pyogenic granuloma, it is never seen with as much regularity or in as much quantity as in the peripheral giant cell reparative granuloma.

The presence of hemosiderin and hemorrhage is also a constant finding in the "brown node" of hyperparathyroidism as well as the aneurysmal bone cyst. Hemorrhage, then, is an important part of all giant cell lesions. Microscopic analysis of these lesions also reveals areas of organizing hemorrhage. These areas show fibroblastic proliferation and hemosiderin and an occasional giant cell. It would appear, then, that the most preponderant component of the giant cell lesions is a result of organization of hemorrhage. The source of the hemorrhage is not clear, but trauma is frequently a part of the clinical history. The trauma may consist of a blow or fall on the jaw or an extraction. In hyperparathyroidism, a bone which has been considerably weakened by resorption may be traumatized easily. Thus it may be hypothesized that all giant cell lesions of the jaws are a tissue response to medullary or intragingival hemorrhage. In the aneurysmal bone cyst, however, the presence of blood-containing spaces must also be explained. These spaces contain viable red blood cells, im-

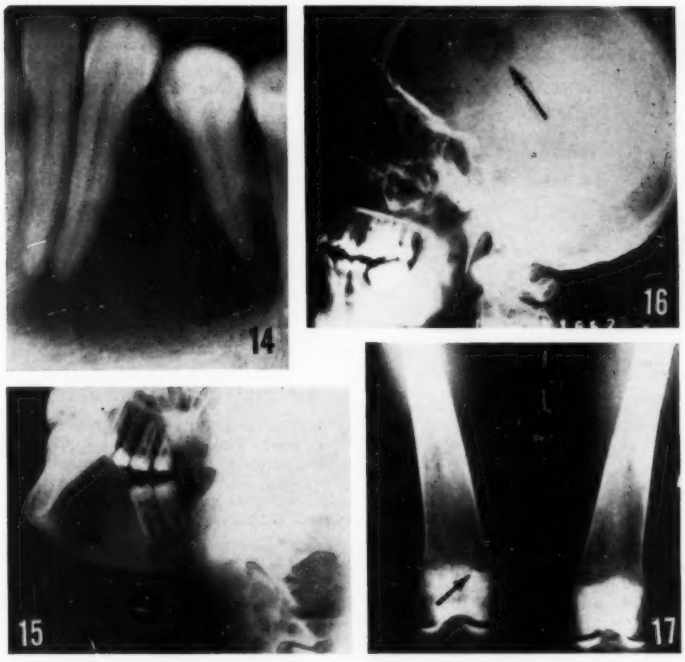

Fig. 14—Roentgenogram of central radiolucent lesion of mandible in 27 year old woman. Lesions extended from lateral incisor to first molar, were swollen and slightly painful. There were no other symptoms. AFIP Acc. 802905

Fig. 15—Roentgenograms taken after extraction of regional teeth. Area is multilocular and cannot be distinguished from follicular cysts, ameloblastoma, central giant cell reparative granuloma or other cystic lesions. AFIP Acc. 802905

Fig. 16 and 17—Roentgenograms of skull and long bones taken five months after jaw lesion of the patient described in Figures 14 and 15. Note radiolucent lesions

plying that the blood circulates through them. They are not lined by muscle or elastic tissue and therefore they are not blood vessels of any type. Finally, at operation the lesion "wells up" with blood and grossly appears like a sponge. All these features indicate that the aneurysmal bone cyst is a giant cell lesion which, in addition to the other features of its group, is further characterized by a communication with a medullary blood vessel. As a result of this communication, blood slowly circulates through its mass.

It is apparent, then, that the giant cell lesions are neither "tumors," "nodes," nor "cysts," that they are merely an unusual response of the oral tissues to hemorrhage and that they are treated by local conservative removal (the brown nodes, of course, excepted).

Table 4

Some theories concerning the origin of giant cell lesions

Aneurysmal bone cyst	Theories
Ewing[22]	Aneurysmal variant of benign giant cell tumor
Lichtenstein[4]	Thrombosis followed by congestion of vascular bed
Central giant cell reparative granuloma	
Brannin and Christensen[15]	Genetic predisposition
Geschickter and Copeland[23]	Disturbance in bone apposition and resorption
Jaffe[24]	Related to hemorrhage and local granulomatous repair process
Peripheral giant cell reparative granuloma	
Bernier and Cahn[17]	Trauma and hemorrhage
Cooke[12]	Observed that 42 per cent (of 101 cases) occurred in women during the child-bearing period
Colby[25]	Inflammatory gingival enlargement

These lesions do not behave the same way as the giant cell tumors of long bones. The latter tumors, resembling the jaw lesions in some aspects of their morphology, are locally aggressive, sometimes metastasize to distant organs and often necessitate radical surgical intervention.

GIANT CELL TUMOR OF BONE—Although a theoretical possibility, a genuine giant cell tumor of the jaws has neither been reported in the literature nor was it seen in the present series. This lesion is usually observed in the epiphyses of long bones and particularly those of the tibia, femur and the radius. It is believed that about 50 per cent of these have a favorable prognosis. One third are locally aggressive and recur, and about 15 per cent are malignant and metastasize to the lungs.[21] Microscopically, the benign giant cell tumor of bone cannot be distinguished from the central giant cell reparative granuloma. On the other hand, none of the giant cell lesions of the jaws are known to have metastasized. For all practical purposes, therefore, it may be concluded that the giant cell tumor, as seen in the long bones, does not occur in the jaws. It is for this reason that this lesion is not discussed in the present report.

■ *Summary*

The study described herein was based on 104 cases filed at the Armed Forces Institute of Pathology under the diagnoses of giant cell epulis; giant cell tumor, giant cell lesion, central and peripheral giant cell reparative granulomas and aneurysmal bone cyst of the mandible or maxilla.

Giant cell lesions of the jaws may be classified as aneurysmal bone cyst, peripheral giant cell reparative granulomas, central giant cell reparative granuloma and giant cell node of hyperpara-

thyroidism. The microscopic features of these four lesions are identical. In the aneurysmal bone cyst, however, numerous pools of blood are also seen.

Aneurysmal bone cyst and the central giant cell reparative granuloma usually develop when the patients are less than twenty years of age. They are associated with trauma, resemble each other in their roentgenographic and clinical features, may produce malocclusion and tooth migration, are more frequent in the female, involve the mandible more frequently than the maxilla, and do not recur after removal.

The peripheral giant cell reparative granuloma involves only the gingiva or the alveolar mucosa of the edentulous ridge, may occur at any age, is more common in the male, involves the maxilla and mandible equally, clinically is indistinguishable from numerous lesions, among them the peripheral fibroma, pyogenic granuloma, and the pregnancy tumor, and does not recur if excised.

The brown node or giant cell lesion of hyperparathyroidism may involve the jaws months before the generalized manifestations of the disease occur. This lesion cannot be treated by local curettage, and therefore any recurrence of a giant cell lesion in the jaws should provoke suspicion of hyperparathyroidism.

It is suggested that all these lesions result from an intramedullary or intragingival hemorrhage.

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The stress phenomenon as related to surgical anesthesia

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With approximately 10 per cent of the population receiving some form of corticosteroid therapy, it behooves the surgeon and anesthetist to recognize such therapy as one of the main contributing factors of adrenocortical insufficiency, particularly if the stress of a general anesthetic is contemplated. Rather than eliminate the hormone treatment, however, the patient should continue on it, and if the major symptoms of insufficiency appear, the administration of soluble hydrocortisone, prednisolone, or hydrocortisone infusion may be a lifesaving measure.

With the discovery of cortisone, one of the steroids isolated from the cortex of beef adrenal glands, considerable interest was aroused in adrenocortical function and the pituitary-adrenal relation. Recently, interest has been focused on adrenocortical function during and after surgical intervention. Since surgical operations are preceded by administration of an anesthetic agent, the anesthetist, too, has played his part in elucidating the effect of surgical anesthesia on adrenocortical function.

Of prime importance to the anesthetist is the recognition of adrenocortical insufficiency. The purpose of this presentation is to discuss the following: (1) causes of deficient adrenocortical function; (2) the means of recognizing such deficiency, and (3) some suggestions on how to cope with this condition to prevent possible death of the patient.

■ *Causes of Adrenocortical Insufficiency*

Three types of adrenocortical deficiency should be considered in relation to the stress caused by surgical trauma. One is adrenal insufficiency resulting from excessive surgical trauma. Another may follow mild surgical trauma because of impaired adrenal function in patients previously treated with adrenocortical steroids or corticotropin. The third type occurs in patients with a greater or lesser degree of non-drug-induced adrenal hypofunction who have less than an optimal adrenal response to stress.

Prolonged treatment with even moderate doses of cortisone or similar acting compounds may result in adrenocortical insufficiency. If therapy is withdrawn abruptly, the patient's reaction is similar to that of a subject with Addison's disease. If corticosteroid therapy is discontinued for a day or two before operation, the superimposed surgical trauma may precipitate an adrenal crisis. This is manifested by metabolic imbalance, particularly in respect to electrolytes and arterial hypotension, which may lead to sudden death.

During surgical procedures it is important to differentiate between arterial hypotension resulting from acute adrenal

insufficiency, reflex hypotension after mechanical stimulation of autonomic areas related to vagal function, and hypotension due to excessive hemorrhage.

The adrenal cortex secretes many different steroids which have various functions. Over 30 adrenal steroids have been isolated, and these may be divided into three groups:

1. Gluco-corticoids – such as cortisone, hydrocortisone, prednisolone and dexamethasone – which affect carbohydrate metabolism and, to a lesser extent, fat metabolism. They influence electrolyte balance, but to a lesser degree than the mineral corticoids.

2. Mineralo-corticoids—such as desoxycorticosterone, the natural sodium-retaining steroid known as DCA, or aldosterone – probably occur in small amounts, if at all, in the adrenals. They produce sodium retention and potassium loss, thereby regulating water balance.

3. Androgens—the steroids responsible for secondary male sex characteristics.

Maintenance of adrenocortical function in the normal subject is controlled by a sensitive and intricate mechanism. The adrenocorticotropic hormone, known as corticotropin or ACTH, is secreted by the anterior pituitary gland. It stimulates the adrenal cortex to produce cortical steroids. Under conditions of stress, such as trauma, infection, or severe anxiety states, the anterior pituitary gland is stimulated to increased activity and, as a result, to increased production of corticotropin. This stimulates the target organ, the adrenal cortex, to produce increased secretion of certain cortical steroids. These steroids are utilized at the site of trauma to reduce inflammation, and they also enter into other metabolic processes involved in body defenses against noxious agents.

Associated with this pituitary-adrenal relation is the functioning of the hypothalamus. Stimulation of the hypothalamus is reflected in pituitary stimulation with increased secretion of corticotropin. Depression of the hypothalamus is reflected in depressed anterior pituitary function and diminished secretion of corticotropin.

It is believed that when a person is subjected to severe emotional stress or trauma, the hypothalamus-pituitary-adrenocortical system may be activated via the sympathetic fibers to the adrenal medulla. This results in a release of epinephrine. The epinephrine enters the blood circulation and thereby influences the hypothalamus to release a humoral substance which produces increased activity in the anterior lobe of the pituitary body and increased secretion of corticotropin. This is reflected in increased activity in the adrenal cortex. Whether the mechanism operates through the production of epinephrine or other stimulatory agents, there is a direct connection between the psyche and soma.

Howard and others[1] studied adrenal function of soldiers injured in combat during the Korean War. Adrenocortical response of intact glands 24 hours after traumatic stress was characterized by:

1. Increased concentration of 17-hydroxycorticosteroids in the blood plasma.

2. Increased urinary excretion of 17-ketosteroids.

3. Diminution of circulating eosinophils in the blood.

4. Significant sodium retention and diminished urinary excretion of sodium.

5. Hypopotassemia and increased urinary excretion of potassium.

Sandberg and co-workers[2] have observed that the administration of corticotropin to patients undergoing surgery, when the level of the 17-hydroxycorticosteroids in the plasma has risen significantly, will result in a further increase in concentration of this steroid. This observation suggests that, during major surgical intervention, the adrenal cortices are not maximally stimulated since exogenous administration of corticotropin can produce additional secretion of adrenocortical steroids.

With impaired function of the adrenal glands, symptoms of adrenal insufficiency are manifest. The types of adrenal insufficiency encountered most frequently are:

1. Primary adrenocortical insufficiency (Addison's disease).
2. Secondary adrenocortical insufficiency (hypopituitarism).
3. Induced adrenocortical insufficiency after prolonged exogenous administration of corticosteroids.
4. Adrenocortical insufficiency due to prolonged stress resulting in exhaustion of the adrenal cortices.

■ *Symptoms of Adrenocortical Insufficiency*

The manifestations of adrenocortical insufficiency are the reverse of those observed when the adrenal glands are stimulated. They include the following:

1. Decreased concentration of 17-hydroxycorticosteroids in the blood plasma.
2. Decreased urinary excretion of 17-ketosteroids.
3. Little or no diminution of circulating eosinophils in the blood.
4. Diminution of sodium concentration in the plasma.
5. Increased excretion of urinary sodium and chlorides.

Administration of general anesthetic agents may interfere with the hypothalamus-pituitary-adrenal relation. It is not clear whether establishment of a state of general anesthesia constitutes a "stress phenomenon" comparable to the stress after trauma. If the stress is not directly attributable to the pharmacologic effect of the anesthetic agent, the possibility of an intermediate mechanism involving disturbed function in the liver and kidney during general anesthesia should be considered. This disturbance may influence adrenocortical activity.

Severe emotional stress in apprehensive patients, prior to surgical intervention, is an important factor deserving serious consideration. Hetzel and others[3] reported that urinary 17-ketosteroids in a group of ten healthy subjects rose from a mean level of 1 to 4 micrograms per minute, while they were tranquil, and 5.6 to 8.3 micrograms per minute, when feelings of apprehension, anger or excitement were present.

■ *Emergency Measures*

To dentists, particularly oral surgeons, adrenocortical insufficiency poses a most important problem. The life of the patient may be placed in jeopardy if the operator is unfamiliar with the factors which may precipitate an adrenal crisis and with the emergency measures which could prove lifesaving.

With approximately 10 per cent of the population receiving corticosteroid therapy for a variety of collagen diseases or other conditions, it is inevitable that

some of these patients will require oral surgical treatment. The notion that corticosteroid therapy, with or without concurrent antibiotic treatment, is conducive to the spread of bacterial infection has influenced some physicians and dentists to recommend withdrawal of hormonal therapy when a patient is to undergo surgical treatment. Abrupt withdrawal of therapy with corticotropin or with hydrocortisone or any of its analogues may produce adrenocortical insufficiency. The superimposition of general anesthesia and surgical intervention may precipitate an adrenal crisis and result in death of the patient within a few minutes or few hours. Fortunately, lifesaving measures are available, and it is hoped that familiarity with these measures will help reduce the mortality rate from this cause.

If a patient has been abruptly withdrawn from corticosteroids, it is advisable to postpone the operation for several days and reinstitute treatment with corticosteroids, particularly corticotropin, rather than to run the risk of precipitating an adrenal crisis. When adrenocortical function has been restored, the operation may be performed and adrenocortical therapy continued with a dosage regimen tailored to meet specific requirements.

Examination records for patients requiring general anesthesia and surgery should include an entry relating to corticosteroid therapy which would indicate whether such therapy had been withdrawn abruptly prior to the examination. This information may prove lifesaving. However, emergency surgical treatment cannot be postponed to permit restoration of adrenocortical function with corticotropin, hydrocortisone or any of its analogues. Under such conditions the patient should receive 100 mg. hydrocortisone infusion concentrate in physiologic saline solution during and immediately after operation. Intravenous injection of 5 to 10 mg. soluble hydrocortisone hemisuccinate or prednisolone phosphate may be used in place of the infusion concentrate. The former is simpler to administer, particularly if repeated dosage is found necessary.

Although great strides have been made in the preparation and administration of general anesthetic agents, comparable progress should be made in clinical research relating to adrenocortical function. With this knowledge many lives could be saved when prompt action is essential and delay could prove disastrous.

■ *Summary*

A review has been made of the fundamentals of adrenocortical function and the modifying role of general anesthesia and surgery. The behavior of patients with induced adrenal insufficiency undergoing minor surgical intervention resulting in adrenal crisis has been described. The beneficial effect of corticosteroid therapy in patients with known adrenocortical insufficiency has been discussed.

The intravenous injection of soluble hydrocortisone or prednisolone or hydrocortisone infusion concentrate is recommended as a lifesaving measure in the event of shock from adrenocortical exhaustion.

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Terminology in the field of tooth plantation

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A preferred terminology is offered for description of the various tooth plantation procedures being studied at the present time. A uniform terminology would help to eliminate much of the confusion existing among workers in this field and to facilitate communication between practitioners in the various fields of dentistry.

For many centuries man has attempted to replace human teeth in the alveolar bone with natural or artificial teeth. Some of these attempts have been successful and many have been failures. The need for a successful method of replacing nonrestorable or missing teeth with natural teeth still exists. Endodontics has played an important role in the saving of many cariously exposed first permanent molars; however, in instances in which endodontic procedures are contraindicated, the extraction of the tooth is inevitable.

Prosthetic replacement is excellent in many instances but in several it falls short of a desirable result. The need for a method for replacing nonrestorable first permanent molars with natural teeth is keenly felt by many dentists who realize the complications resulting from early loss of first permanent molars. The collapse of the dental arch with tipped second molars, extruded maxillary teeth, drifted second bicuspids, increased caries potential, malocclusion with resultant temporomandibular joint dysfunction and even changes in dimension of the middle third of the face are all sequelae.

Not until recent times have members of the profession turned their attention to the transplantation of partially developed teeth to new locations in the alveolar ridge.

In discussing the needs, indications or methods for replacing nonrestorable or missing teeth with natural teeth, the problem of terminology arises immediately. Terms such as replantation, transplantation and implantation have been used with different connotations by various authors, thus causing some confusion in the literature regarding the meaning of these words and others such as homogenous, homologous, autogenous and autologous. To facilitate discussion in the field of tooth plantation, the following definitions are presented as they pertain to dentistry.

■ *Definitions of Terms*

Replantation—The act of replacing a tooth, with a vital or nonvital pulp, in the same alveolar socket from which it had been removed either surgically or as a result of trauma.

Implantation—The act of imbedding an artificial tooth into the alveolar ridge.

Transplantation—The operation of transferring a tooth, one with a vital pulp or one having had root canal treatment, from one site to another in the same individual or from one individual to another.

Autogenous Transplantation — The transplantation of tissue from one site to another in the same individual. Autogenous means self-originating or origin within self. It is preferred over the term autologous which implies relation but not origin, which is of primary importance in regard to the transplanted tooth. Therefore, autogenous transplantation is the plantation of a tooth to another site but in the same individual in whom the tooth was generated.

Homogenous Transplantation—The transferral of a tooth from one individual to another individual of the same species. The prefix homo- is from the Greek, meaning similar or common; therefore, homogenous means from similar origin.

Heterogenous Transplantation—The transferral of a tooth from one species to a different species. The prefix hetero- is from the Greek, meaning different or dissimilar; therefore, the term heterogenous implies "from different origin."

Isotransplantation — Transplantation of tissue to the same kind of tissue. This term is not applicable in tooth transplantation in that the tissue transplanted is not the same as the tissue bed that receives it. The use of a section of dentin to fill a defect of dentin in another tooth would be described as an isograft.

Homologous and Heterologous — These terms are undesirable for the same reason as given in the definition of the term autogenous.

Homoplasty and Autoplasty—These are not desirable terms in the field of tooth transplantation. The suffix -plasty is derived from the Greek word *plastos* meaning formed, and new teeth are not being formed in these procedures.

Autoplant and Homoplant—These terms are merely contractions of the terms autogenous transplant and homogenous transplant and are not desirable.

■ *Conclusion*

An attempt has been made to select the most accurate prefix or suffix or both to describe the plantation of teeth.

It is hoped that the presentation of these definitions will lead to an accepted and uniform terminology. This would help to eliminate much of the confusion which now exists among workers in this field and to facilitate communication between practitioners in the various fields of dentistry.—*406 Loraine Building.*

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Dental care of hospitalized mental patients

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A positive but understanding approach to the hospitalized neuropsychiatric patients, coupled with the proper physical surroundings, tends to decrease anxiety and apprehension and allows dental treatment to be accomplished for the majority of these patients. In a mental hospital a number of aids are available to help the dental staff, including personnel who may have established a better means of communication with the patient than the dentist, and a vast array of sedative and ataraxic drugs.

Experience has shown that the problems inherent in dental care for the hospitalized, mentally ill patient are basically the same as those manifest in treating the dental patient in the community. After nine years of continuous association with neuropsychiatric hospital dental services, I am thoroughly convinced that the idea that the dental treatment of hospitalized mental patients involves exceptional difficulties is unfounded. The number of successful episodes of dental treatment in Veterans Administration neuropsychiatric hospitals supports this conclusion.

At present there is a general concern about the increasing number of mental patients seen in the private practice of psychiatry, outpatient mental hygiene clinics and hospitals.[1] Presumably many of these mental patients also are receiving dental treatment either in private dental practice or in institutional dental services. The literature is replete with presentations concerning the management of such patients in their community and at state, federal and private institutions; the number of articles indicates that the dental and allied professions have an acute awareness of the problem of dental treatment of the mentally ill.[2,3]

The presence of functional mental disease, even in the gravest forms, does not necessarily preclude dental therapy. As most dentists find in Veterans Administration neuropsychiatric hospitals, it is a small minority of their patients who are untreatable.

The principles of good dental health care are not altered for the mental patient, only the procedures.

■ *Procedures*

The numerous oral conditions presented for treatment usually can be attended with specific remedial steps. However, prior to diagnosis or treatment the recipient should be amenable to his situation.

For the creation of a tolerable situation in a mental hospital, much depends on the psychological approach and the degree of mental disability present. This last is many times cited as being the stumbling block in attempting to treat mental patients. However, the patients with severe mental conditions can be com-

pared to those with severe physical disabilities in regard to the possibility of dental treatment. For instance, patients with severe leukemia, a coronary condition or an acute infection as well as those recovering from surgery often must have dental treatment delayed. The percentage of severely disturbed patients is relatively small in a neuropsychiatric hospital.

The physical surroundings have a definite function in the psychological approach. As in private practice, the waiting room should be appointed in a manner which will give the patient as much physical comfort as possible, and care is taken not to exhibit complicated devices and instruments which might tend to increase the anxiety and apprehension present. Such distractions as music and literature are utilized. The clinic proper contains modern equipment with pleasing color combinations.

It has been found, especially when dealing with schizophrenic patients with paranoid tendencies, that the open type of clinic is better suited than the closed cubical type; the former avoids arousing the suspicions ever present in the paranoid patient. Since usually more than one patient is being treated at one time, the general atmosphere is similar to that employed in group therapy.

The most important factor in the psychological approach to the patient is the attitude of the dentist and his assistants. By definition, attitude is the pose or position assumed to indicate feeling, opinion or mood. By usage it is a means of establishing communication and rapport with the patient.

For the dentist and his staff, genuine interest and understanding, put forth in a kind, firm, reassuring manner, is a must, and by using the ability to interpret a patient's feelings a means of communication is improvised. Thus the situation fraught with possibilities of both psychic and physical trauma can be made acceptable.

To insure and increase the amenability of the patient toward dental treatment, certain rules are followed. These rules are applied in the treatment of the mental patient in general:

1. The use of force must be avoided. If the patient resists treatment, the treatment must be postponed until the patient is more amenable. The dentist should try to win his cooperation, friendship and trust.

2. The patient must not be misled or lied to in an effort to avoid a difficult situation. The patient must be dealt with honestly at all times so that his trust in the dentist will never be shaken; if a question cannot be answered for ethical or other reasons, the patient should be told so honestly but tactfully.

3. The patient's mood must not be allowed to determine the mood of the dentist. A friendly, neutral mood should be maintained regardless of the almost contagious effect of excessive gaiety, deep depression or strong belligerence.

The following rules are for use in treating patients who are uncooperative, who have a tendency to have delusions or hallucinations or who withdraw into emotional seclusion:

1. Negative commands must not be given to an uncooperative patient. He should be told directly what is expected. If he is unable to cooperate, the dentist should assist him in doing so.

2. The dentist should not express

agreement with a patient who has delusions. He should not pretend to experience the sensations the patient experiences through hallucinations. He may listen with interest, but not agree or dispute these false ideas or unreal experiences.

3. The dentist must not be rigid and inflexible in dealing with the uncooperative or stubborn patient. Some flexibility in routine and deviations from set rules of procedure should be allowed in accordance with the needs and abilities of the patient.

The following rules are suggested for the management of paranoid patients:

1. The dentist and staff must not whisper in the presence of paranoid patients. They should speak loud enough so that the patient can clearly hear that they are not talking about him; the dentist and staff also must use as few gestures as possible to avoid stimulating the patient's suspicion.

2. The use of complicated equipment is to be avoided if possible. Simple apparatus should be used to prevent the patient from becoming apprehensive of "dangerous plots" and "instruments of torture."

■ *Aids to the Dentist*

Fortunately, in a mental hospital the physical and psychiatric diagnoses are available to the dental staff, and by properly integrating them with the oral treatment plan many unsuccessful episodes are avoided.

PERSONNEL—At times it is necessary to call on others who have established a better means of communication with the patient so that the objective may be accomplished. In the hospital it may be the physician, nurse, nursing assistant or therapist; in private practice these people are also frequently called on and for the same reasons. As an illustration, this case is reported. A World War II veteran was seen twice a year for five years by every member of the dental service of a large Veterans Administration neuropsychiatric hospital, but to no avail. He consistently refused dental attention; yet after this length of time, he came to the clinic accompanied by a corrective therapist with whom he had established excellent rapport, a relation not attained by the dental staff. In this altered situation it was possible to extract teeth, construct fixed bridgework and complete all other necessary dental treatment.

DRUGS—The use of drugs for their sedative, hypnotic and analgesic effect has long been a part of preoperative dental procedures; however, in the past four years the use of chlorpromazine and reserpine, their derivatives and other products popularly referred to as the tranquilizers, have contributed greatly toward the successful episode of treatment.

In a study made in 1956 at Downey Veterans Administration Hospital[4] it was found that as the use of the tranquilizers increased, the number of patient visits for dental treatment increased by more than 1,200 within a year, and it was the consensus that this increase was directly attributable to the use of these drugs.

There was an interesting sidelight of this study. Many who had refused treatment for a long time finally had their dental treatment completed. These patients were thought to be on tranquilizers,

but they had not received such drug therapy. This gave rise to the feeling that the personnel involved in the dental procedures were more optimistic in their outlook, having been influenced by the claims for the drugs' effectiveness. This optimism, when communicated to the patient, conceivably resulted in favorable episodes of treatment.

■ *Achievements*

The statistics dealing with the dental treatment of hospitalized psychiatric patients substantiate the claims that a relatively small minority are untreatable. In a 1,650 bed neuropsychiatric hospital the number of patient visits for treatment varies between 2,000 and 2,400 per quarter. These figures do not include about 800 visits for initial or recall examinations, for a total of 2,800 to 3,200 patient visits quarterly. Of the patients for whom treatment in all phases of dentistry is prescribed, about 80 per cent have their treatment completed. Only 8 per cent cannot be treated at all.

These treatments are accomplished by dentists and staff who have had little training in basic psychiatry or psychology, a point brought out by Crandell,[2] who advocates including such training in the undergraduate dental curriculum.

■ *Summary*

Some factors relevant to dental treatment for hospitalized psychiatric patients have been presented. With only slight modification most of the cited factors also pertain to practices in the general community. It is the author's belief that the problems found in the dental care for the hospitalized, mentally ill patient are neither different from, nor significantly greater than, those inherent in the treatment of any other dental patient. In many instances since information regarding the physical and mental diagnosis is more readily available in the hospital than in practice in the general community, dental treatment can be instituted more easily.

*Chief, dental service, Veterans Administration Hospital.

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■ EDUCATION AND INDOCTRINATION

A good teacher should enjoy hearing the ideas of his students and should also enjoy telling his students his own, but has no plan making them think as he does. If the student thinks as the teacher does that may please the teacher; but if he does not, the honesty of the student's thought will please him just as much. That is just the difference between education and indoctrination.—*Alan Paton. The Land and People of South Africa.*

How Blue Shield has affected my practice

■ *Irvin V. Uhler,* D.D.S., Lancaster, Pa.*

Blue Shield coverage in Pennsylvania is exerting a favorable influence on oral surgery practice. It has enabled more people to take advantage of the skills and services of the highly trained specialist. The end results are better patient care, maintenance of high standards of surgical practice, and prompt and adequate financial compensation for the surgeon.

The Medical Service Association of Pennsylvania in its Blue Shield Fee Schedule and Manual provides for oral surgical services as follows: "Payment for eligible Oral Surgical Services provided by a Doctor of Dental Surgery will be made ONLY when the subscriber is an in-patient in an accredited hospital and the doctor is a member of the staff of the hospital (or has courtesy privileges). (Under the Master Agreements, general oral surgery is not included but payment is made to the Doctor of Dental Surgery for the reduction of fractures and dislocations of the jaw either in or out of the hospital.)"

Under the fee schedule, procedures on teeth and gums are delineated as shown in the table.

In analyzing the effect of Blue Shield in my practice, several basic factors must be established clearly. First, in Pennsylvania, Blue Shield pays only for surgical procedures carried out in an accredited hospital, with the exception of those mentioned previously in the Master Agreements. Second, I am in a two-practitioner office and our practice is limited to oral surgery. As specialists in oral surgery, a large portion of our practice is referred by general practitioners of dentistry and from the medical profession. Consequently we have a larger proportion of Blue Shield policyholders than would a general practitioner of dentistry who would not have the benefit of such referrals. Third, we are geographically located in an area with about an even balance between agriculture and industry. The agricultural population is composed to a great extent of members of Amish and Mennonite sects, whose customs preclude insurance as we know it.

Our industries, although varied, do not include a large steel mill within the county. These industries buy their insurance on a competitive basis, and by deleting some benefits, obtain less expensive coverage. Consequently, their benefits fall far below Blue Shield standards. Of our three major industries, only one has insurance with a level of benefits approaching that of Blue Shield. In the adjacent counties there are several large steel plants, all covered by the Master Agreement which the subscriber can supplement at little personal outlay to receive full oral surgery benefits. Many of these employees are referred to our practice. Thus it must be understood that our practice is in a section where Blue Shield is

Table
Blue Shield fee schedule

	Plan A ($)	Plan B ($)
Surgical removal of teeth (impacted only)		
Soft tissue impaction	10.00	10.00
Partially covered by bone	25.00	35.00
Completely covered by bone	50.00	75.00
Limit for one hospitalization not to exceed $100.00 under Plan A and $150.00 under Plan B. After removal of first impaction, the remaining impactions will be paid for at one-half rate		
Dental root resection: apicoectomy, one	35.00	35.00
Alveolectomy: areas occupied by not less than six teeth	25.00	35.00
Alveolectomy: maxillary and mandibular	40.00	60.00
Excision of radicular cyst—extensive	100.00	150.00
Excision of dentigerous cyst—extensive	100.00	150.00
Removal of foreign body	50.00	50.00
Repair of torus palatinus	50.00	75.00
Sialolithotomy: removal of salivary calculus		
Intraorally	25.00	40.00
Extraorally	75.00	100.00

comparatively weak in membership, but bounded by sections where it is very strong in membership. The bulk of our local Blue Shield coverage is on an independent purchase basis which is understandably higher in cost than group coverage.

The following shows the percentage of our gross income for the past five years which came from Blue Shield payments:

In 1953, 30.80 per cent of our gross income was derived from hospitalized patients. Blue Shield paid 3.09 per cent of our gross income and commercial plans paid 2.63 per cent.

In 1954, our income from hospitalized patients amounted to 39.22 per cent of our gross income, 4.76 being paid by Blue Shield and 5.26 by commercial plans.

In 1955, hospitalized patients provided 42.79 per cent of our gross income, Blue Shield paying 4.16 per cent and commercial plans, 5.71 per cent.

In 1956, our portion of gross income from hospitalized patients rose to 50.50 per cent, with Blue Shield paying 9.60 per cent and commercial plans 7.50 per cent of the gross income.

In 1957, that portion of our gross receipts from hospitalized patients dropped to 43.55, with Blue Shield paying 11.39 per cent and commercial plans providing 9.46 per cent of our gross income.

The allowances under Plan A of Blue Shield represent the average fee for surgical services in our region, but are lower than average fees in our larger cities. The allowances under the Plan B schedule are above the average fees in Lancaster County, and about on a par with fees in the larger Pennsylvania cities. In our practice this results in good rapport between patient and practitioner. Patients who previously had to be served in outpatient clinics, or receive surgical care on the level of general practice training and experience, now have the benefits of care from trained specialists of their own choosing. At the same time the financially independent patient is pleased to have all or most of his surgical cost paid by his Blue

Shield program. The general practitioner of dentistry is more inclined to refer his patient to a specialist if he knows that Blue Shield is protecting the patient from a heavy or burdensome financial outlay.

The effect of this attitude goes far beyond monetary considerations. We are seeing many younger patients with impaction and growth problems. During the summer months and during other periods of school vacations, many patients between the ages of 16 and 22 are being hospitalized for the removal of impacted teeth and correction of growth problems about the jaws. Heretofore the attitude of the dental practitioner, and his advice to the patient, consisted of "Let it go until it bothers you." As recently as five years ago we had many patients above the fifth decade of life with serious infection-impaction problems, many complicated by massive cysts, and there were comparatively few patients under 25. Now the reverse is true. The patient over 40 with problems is becoming an exception. We have many patients between 25 and 35, but the majority are under 25. Thus Blue Shield is helping us meet surgical management problems while the patient has youth on his side. Teaching centers are in accord in the idea that any tooth not in functional position by the time the patient reaches 25 years of age should be removed. Once a patient passes the third decade of life, impaction problems especially become increasingly formidable.

Naturally the patient facing a surgical problem will be less prone to delay the inevitable if he has the financial protection the Blue Shield program provides. Less patient resistance is met when the need of an operation is presented to the patient or a parent. The time required for preoperative interviews is greatly reduced, offering us more time for better preoperative evaluation of the patient. Then too, the patient comes to the doctor with confidence, knowing that he is a participating doctor in Blue Shield. Hence there is little or no need for questioning the doctor's professional background or experience. The patient loses no time and suffers no embarrassing inquiries as to his ability to pay, nor can he use lack of money as an excuse to defer needed surgery. His Blue Shield Plan has already discharged this obligation.

There is no tendency for the patient to make needless postoperative visits. He knows that the cost of these visits is not included under his coverage and will come out of his pocket. The consultation fee allowance which Blue Shield makes, simplifies the management of patients with chronic or complicating diseases. It opens the door to better patient management through allied medical help, and removes the temptation to "go it alone" when a patient's history is doubtful.

In our practice we cover a hospital for children with rheumatic fever, and I am the oral surgeon to the Lancaster Cleft Palate Clinic. Patients in both of these institutions require allied medical evaluation and management, and for the patient who has Blue Shield, there is no additional financial burden. We also are consultants for three distant hospitals. These are near a high speed highway, the Pennsylvania Turnpike, and are near steel mills. The location results in calls involving traumatic surgery. Here Blue Shield protects us against loss of income or deferment of income, as the highway accident

and industrial accident usually become matters for litigation, and payments are usually withheld until settled by a court. These outlying hospitals, with the accompanying professional and lay contacts in areas with a high percentage of Blue Shield members, have been important factors in the development of our practice. There is no hesitation on the part of personnel of these institutions to call us as far as 50 miles to care for injured patients, for there is no problem of adequate remuneration for lost overhead through distance and travel time. The contacts made on cases such as these have been great builders of good will and referrals.

Many times, poor-risk patients with an aversion to hospitals will try to prevail on us, against our better judgment, training and experience, to perform a necessary surgical procedure in the office. The Blue Shield clause requiring hospitalization in an accredited hospital immediately removes any temptation to do so, and assures proper management of the patient with appropriate medical consultation and comanagement. The patient is further protected: in order to receive benefits, the patient must be an in-patient in an accredited hospital under the care of a Doctor of Dental Surgery who is a member of the staff or who has courtesy privileges. Thus the patient runs little risk of falling into the hands of a charlatan.

I feel that the requirement for hospitalization is just and sound, and I personally do not wish to see these benefits extended to the office level. My personal justification of this attitude is the silent discipline ever present in accredited hospitals. This assures constant maintenance of high standards of care for the patient.

Since Blue Shield has become available, I see very little of the meddlesome surgery, completely or incompletely terminated, that oral surgeons have been so familiar with in the past. Any practitioner from time to time will find himself in trouble, innocently. But this type of surgical coverage has all but erased injudicious office oral surgery by general practitioners. The general practitioner realizes that attempting surgery for which he has not been trained is completely unthinkable in today's economic picture. In the last two years we have averaged less than six referrals a year involving meddlesome surgery. This brings a great feeling of pride in our profession and assurance that it is coming of age through better educational backgrounds, and due in part to plans such as ours bringing skilled care to increasingly greater numbers of the population.

In all fairness, such an evaluation as this must look at all sides of such a program. Naturally there are disadvantages, abuses and attendant evils. Fringe groups who will seek selfish or dishonest advantage exist in any profession or occupation. In Pennsylvania unfair advantage has been taken in instances of alveolectomies and cysts. Too many patients having multiple extractions which are routine office procedures have been coming into the hospital because of the allowance for alveolectomies which were described earlier. This to me is a fundamental dishonesty. After thorough study by the executive committee of the Medical Service Association of Pennsylvania, the board of directors, as of September 1, 1958, decided that the paying for an alveolectomy when performed as a related and inci-

dental procedure to a service (extraction of teeth) which is definitely not covered by the agreement, should be stopped. The other offense has been in regard to cysts. At the inception of the program, no limit was imposed as to minimum size, and abuses occurred frequently with the dental granuloma. Consequently it became necessary to include only cysts measuring greater than 2 cm. in any diameter. There have been isolated instances of practitioners overstepping their limitations, but happily these are in a minority, because of the accredited hospitals' standards for surgical staff privileges.

From time to time men will want to become participating doctors because of the benefits allowed. In our hospital any member of the Lancaster County Dental Society may admit patients for oral surgery on a private basis (wards are closed) after he has been cleared by a member of the dental staff of the hospital in operating room technic and surgical ability. On his first admission he will be accompanied by a member of the staff, empowered to take over in any instance of incompetence.

There are patients who will try to take unfair advantage of Blue Shield; some subscribers will demand to be hospitalized for multiple extractions which belong on the office level, wanting in reality a hospital vacation. They fortify their attitude with the statement to the effect that they have been paying into the program for years and want something out of it. Others bluntly demand that we file a claim for impacted teeth in instances in which routine extractions are involved. When we point out that we have on file with Blue Shield an authorization to examine our records in any hospital at any time, the patient usually comes into line. Of course there are exceptions, but we take the stand that this minority would constitute an unsatisfactory segment of our practice, and withhold treatment.

Whenever Blue Shield has had occasion to challenge or question claims from our office, their attitude has always been justified. In every instance a satisfactory agreement has been reached.

Naturally I carry Blue Shield myself, and I hope I will be able to participate in it as long as I may practice. It is the Doctor's Plan, and a bulwark against socialization and government agency interference in the doctor-patient relationship. Unquestionably, our Blue Shield patients are greatly benefited by their coverage, particularly those with lower income levels, and the higher income patient benefits too. My office is very well served by the plan. I am paid for the care of many patients whom I would otherwise be unable to treat as private patients. My payment is prompt, and more prompt than that from the average patient. This is important to an oral surgeon, in view of his excessive overhead.

A program such as Blue Shield cannot help but improve the practitioner-patient relationship, the standing of dentistry among the healing arts, and the stature of the practitioner on the local level.—*548 North Duke Street.*

Presented as part of a Forum on Dental Practice, Part IV, "Efficient, Effective Dental Care for More Patients," ninety-ninth annual session, American Dental Association, Dallas, Texas, November 12, 1958.

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VOLUME 17 • JULY 1959 • NUMBER 4 CASE REPORTS

Transitory Bell's phenomenon after mandibular injection: *report of case*

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A review of the dental and medical literature and textbooks reveals many articles concerning transitory facial paralysis or Bell's palsy.[1-14] Paralysis of the peripheral portion of the seventh cranial nerve is commonly seen and may result from exposure to cold, infection, trauma, neoplasms, and systemic disease.[1-2] Bell's phenomenon is adequately described in textbooks.[1,2,13] The patient usually is unable to raise the lip, whistle, wrinkle the forehead, or close the eye on the affected side. When an attempt is made to close the eyelid, the eyeball rolls upward, leaving only the white of the eye visible. Other symptoms which may occur are loss of taste, pain, tinnitus, and vertigo.[7]

Very little mention is made in the literature of facial paralysis after injections of anesthetic solutions. Sicher[9] states that paralysis of the entire facial nerve or one of its branches may occur after mandibular block anesthesia. He feels that this is caused by a direct influence of the solution on the motor nerve, either by injecting directly into the parotid gland, diffusion of the solution into parotid tissue, or because of an anatomic anomaly in which the parotid gland does not envelop the facial nerve where it crosses the retromandibular space, thus exposing the nerve to the drug if it is injected close to the posterior border of the mandibular ramus.

DeBats and Phillips,[3] in studying nerve injuries incidental to dental surgery, felt that temporary facial paralysis was due to advancing the needle too far back into the parotid gland or too high through the sigmoid notch of the ramus into the parotid gland. In describing the symptoms which occur after this type of injection, they mention a drooping of the lips and eyelids but no mention is made of the eyeball rolling upward as in Bell's paralysis.

Stoy and Gregg[12] reported a case of a woman who was given a mandibular injection in preparation for the extraction of a mandibular second molar. No mention was made of the anesthetic used. After extraction of the tooth, a tingling sensation was felt on the side of the face. Bell's symptoms occurred five days later. After searching the literature they concluded that facial paralysis after inferior alveolar nerve injections may be due, in some instances, to the direct action of the solution on the nerve itself, but that in others it is the result of a vascular reflex which causes an ischemic paralysis in the region of the stylomastoid foramen.

The following is a case report in which a transitory Bell's palsy was demonstrated immediately after a mandibular injection of a local anesthetic solution. No reports of a similar case could be found in the literature.

REPORT OF CASE—The patient, a healthy 24 year old white man, reported to the dental clinic for extraction of an impacted left man-

dibular third molar. In preparation for this routine surgical procedure, the attending dentist injected 2 cc. of a local anesthetic solution (2 per cent lidocaine with epinephrine 1:50,000) in the region of the mandibular nerve. Within two minutes after injection, the patient complained that he couldn't close his eye.

Clinical examination revealed that the patient was in acute distress and very concerned about his condition. He could not raise the left corner of his mouth nor could he wrinkle his forehead. The left eyelid could not be closed and the eyeball was rolled upward, exhibiting only the white of the eye. He complained that the entire left side of his face was "painful to touch." Within several minutes the painful sensation disappeared and complete facial paralysis of the left side was evident. The patient then appeared to fall into a semi-stupor and complained of a "tingling" in his arms, combined with a visible twitching in his upper and lower extremities.

The attending dentist was questioned concerning the site and technic of the mandibular injection. The provisional diagnosis was that either the injection had acted as a traumatic stimulus to precipitate a true Bell's palsy or that possibly the anesthetic solution had been deposited into the parotid gland tissue, thus anesthetizing the branches of the facial nerve which lie within the gland. Rapid absorption of the drug from this region plus extreme concern and anxiety were believed responsible for the onset of the convulsive twitchings.

To counteract the anxiety and twitchings, 1.5 grains of secobarbital sodium was slowly administered intravenously until the symptoms ceased. The patient was then removed to a hospital bed for observation. During the next hour, he attempted to sleep but he was very uncomfortable because of the inability to close his eye.

Approximately one and one-half hours after the mandibular injection, the patient stated that "feeling was coming back to his face," but the paralysis still persisted. An hour later, he was able to raise his entire lip and move his facial muscles; however, he still was unable to control his eye or eyelid until an hour later. He was kept under observation for several hours after disappearance of all symptoms and then discharged from the hospital. Subsequent observations after his discharge revealed no significant changes. No camera was available to record the patient's facial condition at the time of the occurrence.

SUMMARY—A patient was seen in whom a transitory facial paralysis resembling Bell's palsy occurred after injection of the mandibular nerve with a local anesthetic solution. It is believed that the solution was inadvertently injected into parotid gland tissue, thus anesthetizing the branches of the facial nerve. The patient fully returned to normal after absorption of the solution from the region.

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Tetanus complicated by impacted dentures: *report of case*

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Recently a case of localized tetanus with acutely painful trismus and impacted dentures was encountered. Because of the unusual nature of such a complication, this case is reported.

CAUSATIVE ORGANISM—Tetanus is caused by *Clostridium tetani*, which is a spore-bearing, gram-positive, anaerobic organism, apparently first demonstrated by Nicolaier in 1884.[1] Its bacterial growth is enhanced by the presence of necrotic tissue and by the anaerobic atmosphere of deeply penetrating, so-called dirty wounds. *Clostridium tetani* in such an environment produces a potent neurotropic exotoxin which becomes disseminated probably by spread along the nerve trunks and possibly also through the circulating blood.[2] Through the effects of this exotoxin on the central nervous system, localized or generalized muscle spasms, convulsive movements, and muscular rigidity may develop.

CAUSATIVE WOUNDS—In the 91 cases reported by Christensen and Thurber,[3] males predominated by more than 2:1, and 59 of the patients were from farms. In about three fourths of the patients the condition occurred after puncture wounds and various lacerations and abrasions. In five instances no wound could be identified as a focus for tetanus. In none of the patients did the condition occur after a dog-bite wound, which seemed to be the causative wound in the case to be reported.

SYMPTOMATOLOGY—The incubation time may vary from a few days to several months but usually ranges from 6 to 15 days. The median incubation time in one series was nine days.[3] Classically the initial symptoms are stiffness and aching of the neck, jaw and face. This is soon followed by spasm of the muscles of mastication with difficulty in opening the mouth, giving rise to the layman's impression of "lockjaw." Christensen and Thurber noted trismus in the course of 99 per cent of their cases. Dysphagia soon follows and the patient may become completely unable to swallow liquids and even mucosal secretions. A distorted grin (risus sardonicus) may appear because of spasm of the facial muscles.

As the illness progresses, stiffness of the neck, generalized or localized muscle rigidity, opisthotonos and various convulsive manifestations may develop. Severe tonic and clonic convulsions occurred in three fourths of the cases of Christensen and Thurber and may be precipitated by the slightest stimulus such as a sudden noise. During the course of the disease reflex clonic spasms may occur as often as every few minutes. The patients usually retain consciousness and may or may not complain of severe pain. Fever, profuse perspiration and tachycardia may indicate the presence of complications. Laboratory determinations of urine, blood and cerebrospinal fluid usually demonstrate no diagnostic abnormalities.

MORTALITY—In former years the mortality rates ranged from 60 to 70 per cent. However, Christensen and Thurber reported only 27 per cent deaths in their cases treated during the last decade. It has been noted that mortality rates tend to be higher in infants and in older adults. Recently, however, Forbes and Auld[4] were able to report 15 consecutive recoveries from generalized tetanus in children, two of the patients being week-old infants in whom the condition had an umbilical focus.

A striking inverse relationship has also been observed between the length of the incubation period and the severity or mortality of the disease.[3] When the incubation period is less than four days, the disease is usually so fulminating that in most instances it ends fatally.

ACTIVE THERAPY OF TETANUS—Early diagnosis is of vital importance so that treatment can be instituted promptly. Cultures of the wound may be taken but should not delay therapy. Christensen and Thurber found positive cultures for *Clostridium tetani* in only about one fourth of their cases.

Any circulating toxin should be neutralized before it can produce further neurotropic difficulties. Tetanus antitoxin should be given promptly in dosages of 30,000 to 100,000 units with appropriate testing for sensitivity. Intrathecal administration has been found to have no advantage over administration by intramuscular or intravenous routes.[5]

Any existing focus of tetanus should be eradicated to prevent further toxin production. Debridement or other surgical procedures may be necessary, and penicillin should be given because of its bactericidal action on *Clostridium tetani*.[6] Local injection of antitoxin immediately adjacent to the suspected wound seems of questionable value.

General nursing and medical supportive care is of utmost importance in management of the patient with tetanus. Many patients undoubtedly need full-time special nursing attention in a semidarkened, private room. Sedatives must be administered judiciously with extra care to avoid oversedation. Morphine should not be used because of its respiratory depressant action. Curarelike and mephenesinlike drugs may be helpful in selected instances. Initially, parenteral fluids must be employed to maintain nutrition and obviate the possibility of aspiration. Corticosteroids have also been used in selected instances with inconclusive results.[3]

The most common fatal complications are pulmonary in nature and consist of laryngospasms, pneumonia and atelectasis. It is imperative that an adequate airway for proper pulmonary ventilation be rigidly maintained. Forbes and Auld had found it necessary to perform a tracheotomy in 10 of their 15 patients who recovered and bronchoscopic aspiration in 5. They felt that these procedures were life-saving in many instances and that they should probably be performed more frequently and at an earlier stage in this disease.

Christensen and Thurber credited their improved results in part to the formation of a "tetanus team" composed of consultants in internal medicine, pediatrics, neurology, orthopedics, plastic surgery, anesthesiology, bacteriology, pathology and physiology. By the combined efforts and interests of such a group they felt that better care could be made available for these patients with fewer complications and deaths.

IMMUNIZATION OF PATIENTS WITH WOUNDS AND NO PREVIOUS ACTIVE IMMUNIZATION—Most American physicians give tetanus antitoxin if there has been a break in the skin, for tetanus may complicate minor injuries such as in the present case. Press[7] in 1948 studied 982 cases of tetanus and found 15 per cent occurred after so-called trivial injuries. The dosage of tetanus antitoxin in such minor wounds is not agreed on by all investigators, but usually ranges from 1,500 to 5,000 units, depending somewhat on the severity of the wound.

Some authors[8] have suggested that tetanus antitoxin should not be administered in such minor wounds because the risk of serum reactions outweighs the likely benefit of the serum. However, Moynihan[9] in an analysis of 7,580 injections of tetanus antitoxin found serum sickness in only 2.5 per cent and localized reactions in only 2.7 per cent. He emphasized the medicolegal importance of written rules and regulations regarding tetanus serum administration in hospitals and other medical institutions.

The patient should be tested for sensitivity to tetanus antitoxin by either the intradermal, conjunctival or scratch methods. False positive reactions occasionally occur and may be obviated by testing with smaller and diluted amounts.

Laurent and Parish[10] feel that these skin-testing methods are not reliable and prefer to use the "trial dose" method. They administer preliminary subcutaneous injections of tiny amounts and watch for generalized effects. If two or three such injections are unattended by systemic symptoms, they feel that the patient will not react in an anaphylactoid manner and give the full dose of tetanus antiserum intramuscularly.

Protection after tetanus antiserum is only temporary. Its effect is maximal after a few days and probably totally inadequate after three weeks. All patients receiving tetanus antiserum should immediately be started on active tetanus toxoid immunization.

If the wound is extensive and potentially dangerous, such as a compound fracture, crushing injury, deep puncture wound, or severe burn, larger amounts of tetanus antitoxin such as 5,000 to 10,000 units or more are indicated along with penicillin or other antibiotics and supportive measures. Giving the larger dosage initially obviates the need for a second injection later at the very time when sensitivity to the first dose might be developing. Active toxoid immunization in these severe instances should probably be delayed four to eight weeks but even then certainly given.[8]

Cases of tetanus are occasionally encountered in patients who have had preventive tetanus antitoxin. In the 15 cases reported by Forbes and Auld,[4] two of the patients previously had received antitoxin. In many of these instances either the amount may have been too small or the administration too delayed.

IMMUNIZATION OF PATIENTS WITH WOUNDS AND PREVIOUS ACTIVE IMMUNIZATION—Looney and co-workers[11] found that a booster tetanus toxoid injection restores adequate blood levels of antitoxin any time up to ten years after the last toxoid injection, if the previous immunization was complete. In these instances the antitoxin titers rise to protective levels by the sixth day and reach their peak in two to three weeks. Thus in most instances booster toxoid injection should protect the patient adequately. However, in the event of multiple or extensive injuries, especially about the head or neck, uncertainty regarding the time and completeness of the previous toxoid immunization, or delay in administering the emergency booster toxoid, simultaneous injection of prophylactic tetanus antitoxin provides an additional safeguard.

IMMUNIZATION OF PATIENTS WITH NO WOUNDS—The use of routine tetanus toxoid inoculation for all United States and British military personnel in World War II demonstrated unequivocally the remarkable effectiveness of this product. Only 14 cases of tetanus were encountered in the United States Army and Navy during this entire period.[11] Since then active immunization of children with tetanus toxoid has become a routine procedure, but its use in the adult population has been sporadic.

In the military services at present all personnel are immunized with two or three toxoid injections. A so-called recall injection is routinely given in 6 to 12 months and regular booster doses every 4 or 5 years.[11] Undoubtedly active immunization of the civilian adult population should be similarly encouraged in view of the effectiveness against such a dangerous disease, the virtual absence of any side reactions, and the avoidance thereby of the use of tetanus antitoxin except in extreme instances.

Tetanus toxoid immunization should be considered mandatory for certain types of adults. Any person with evidence or past history of allergy should receive this protection. Any person who has had tetanus antitoxin should be given active toxoid immunization, for it is known that subsequent antitoxin injections are likely to have higher reaction rates and reduced benefits.[12] Any person who has had tetanus should be protected with toxoid, for recovery from tetanus does not produce permanent immunity.[13]

REPORT OF CASE—A 65 year old white railroad employee was first seen at the Carle Memorial Hospital Clinic for an outpatient examination on November 20, 1947. His main complaints then were painful right shoulder

and headaches. The results of the physical examination were not remarkable and laboratory studies were within normal limits. No significant abnormalities were detected in roentgenographic examination of the chest, right shoulder, skull and entire spine. Final diagnoses then were fibrositis and migraine. During the next several months of observation and treatment, these difficulties gradually subsided.

He returned to the oral surgery department on July 18, 1956, complaining primarily of mandibular trismus which was aggravated considerably by his inability to remove upper and lower complete dentures. The present illness had begun about six days before admission and about nine days after he was bitten on his right thumb by the family dog. The wound had been very superficial and could scarcely be seen on careful examination. He had first experienced difficulty in talking and thought that he had a common cold. Soon thereafter he could not open his mouth and had been unable to take any food or liquids for two days. He had not suffered from emesis, dyspnea or generalized muscle cramps but periodically complained of painful spasms in the jaw muscles, especially on the right side. He had received no tetanus antitoxin, and therapy elsewhere had consisted of antibiotics and palliative measures.

Physical examination revealed an alert elderly man in considerable distress. All muscles of mastication were clamped bilaterally upon complete dentures, which could be separated only to a maximum of 2 mm. Rectal temperature was 100.2°F. and blood pressure measured 120 mm. mercury systolic and 80 diastolic. The ability to bend the neck forward was slightly reduced, but the results of physical and neurological examinations were otherwise objectively negative except for a soft systolic apical murmur.

Routine urinalysis showed slight glycosuria, but fasting blood sugar was within normal limits (106 mg. per hundred cubic centimeters). The hemoglobin level was 13.2 Gm. The erythrocyte count was 4,600,000, and the leukocyte count was 13,600 per cubic millimeter of blood with normal differential distribution. The Westergren sedimentation rate was 11.0 mm. in 45 minutes. Kline and Kahn tests were negative. Blood urea determination measured 42 mg. per hundred cubic centimeters of blood. The electrocardiogram was normal. Roentgenographic examination of both temporomandibular joints showed slight narrowing and sclerosis on the right, but films of skull and chest were considered normal. Spinal puncture through the fourth lumbar interspace revealed 9 cm. water pressure, one lymphocyte, 64 mg. total protein, negative Kahn test, and 0000000000 colloidal gold reading.

On the day of the patient's admission, one diathermy treatment was given to the jaw muscles, without significant relaxation. Intravenous infusions were needed to supplement the minimal oral intake of liquids, and penicillin in large dosage was started. Meperidine hydrochloride and barbiturates were periodically administered subcutaneously for pain and restlessness.

On the following day with the patient under thiopental sodium-succinylcholine chloride anesthesia, the trismus was relaxed sufficiently to allow removal of both dentures intact. Pharyngeal examination revealed no significant abnormalities. Free movement of the mandible under anesthesia demonstrated that the temporomandibular joints were not ankylosed. The trismus was believed to be due to muscle spasm and most likely to tetanus. The skin test for tetanus antitoxin was negative, and 40,000 units were given parenterally in divided doses followed by 60,000 units the next day.

During the next week the patient's condition remained about the same. He could not swallow liquids, and mechanical aspiration was at times necessary. Intravenous infusions were given regularly, and considerable sedation was required. Small intramuscular doses of d-tubocurarine chloride were used occasionally, with symptomatic relief.

On July 24, an itchy rash developed which rapidly became disseminated and refractory to usual measures. It was thought to be the result of either penicillin, barbiturate or tetanus serum therapy. Daily injections of ACTH in gradually decreasing dosage over a ten day

period afforded great relief. By August 1, the patient was eating and drinking well enough to stop the intravenous infusions. During the next two weeks of hospitalization, the patient's condition gradually improved, and he was discharged with instructions to take vitamins and sedatives. At that time the intermaxillary opening in the anterior incisor region was approximately 26 mm. Only one denture could be inserted, and jaw exercises were advised.

When seen as an outpatient two weeks later, he was able to open his mouth 32 mm. and was feeling stronger. Tetanus toxoid immunization was started. Three weeks later the jaws opened 42 mm. and the dentures were well tolerated. When last seen November 14, 1956, he was feeling much improved but had decided to retire from further railroad employment. A recent letter from the patient stated that he could now open his mouth normally and had no general complaints.

SUMMARY AND CONCLUSIONS—An unusual case of tetanus complicated by impacted dentures is reported. Attention is directed to the difficulty in making an accurate differential diagnosis between this condition and a pathologic condition of the temporomandibular joint. Oral surgical treatment proved to be particularly challenging and rewarding, for with the patient under thiopental sodium-succinylcholine chloride anesthesia, the dentures were removed intact and the patient eventually made a complete recovery.

Patients with tetanus-prone wounds and no history of previous toxoid immunization (such as in the case reported) should receive prophylactic tetanus antitoxin as early as possible after preliminary testing for sensitivity. This should always be followed by active toxoid immunization.

Patients with tetanus-prone wounds and a history of previous toxoid immunization may be protected adequately by a booster toxoid injection, provided the previous immunization was complete and was obtained not more than ten years previously. In certain extreme instances the supplemental administration of preventive tetanus antitoxin also may be advisable.

It is strongly recommended that active tetanus toxoid immunization be employed more routinely in the civilian population, followed by regular booster injections every four to five years or sooner should emergencies arise.

From the departments of medicine and oarl surgery, Carle Memorial Hospital Clinic.

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Nasopalatine cyst: *report of a case*

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The nasopalatine cyst is formed from the remnants of the fetal palatine ducts, where the palatine processes fuse and come in contact with the premaxilla. The duct remnants may be stimulated to undergo cyst formation by any disturbing influence such as infection or trauma. The following case is reported in which trauma may have had an effect.

HISTORY—A 23 year old Negro man was referred to the oral surgery clinic of Strong Memorial Hospital for diagnosis and treatment of a palatal swelling. The patient stated that three days previously he had first noted a swelling in the anterior palatal region with some pain and mobility of the central incisors and the left lateral incisor, and that the swelling had receded since that time. In the past he had received two blows to that region: the first, from a fist when he was a child and the second, from a baseball bat three years prior to his appearance at the clinic.

CLINICAL AND ROENTGENOGRAPHIC EXAMINATION—Intraoral examination revealed a firm palatal swelling extending from the incisor region to the bicuspid region and another tender swelling involving the maxillary labial frenum. All the teeth were tested and the pulps were vital, although the central incisor and the left lateral incisor showed 1° mobility.

Periapical and occlusal films revealed a large radiolucent nonsymmetrical heart-shaped area extending from between the central incisors to the first molar region. The roots of the central incisors were divergent. The area was surrounded by a thin line of cortical bone. The impression was that the condition was a nasopalatine duct cyst (see the illustration).

OPERATIVE PROCEDURE—Because of the size of the cyst, the patient was admitted to the hospital. With the patient under endotracheal anesthesia an incision was made around the necks of the teeth extending from the first molar region on the left side to the first molar region on the right. The mucosa then was reflected and the cyst located. With sharp and blunt dissection the cyst was severed from the palatal mucosa and was enucleated. It was found to be adherent to the deep portion of the labial frenum, having destroyed the bone over the central incisors. The bony palatal defect was 1.5 cm. in diameter, but there was no perforation of the floor of the nose or of the maxillary sinus. The palatal mucosa was replaced and sutured with no. 000 silk. Impression compound was adapted to the palate and was secured to the right and left second bicuspids with 25 gauge wire.

POSTOPERATIVE RESULTS—The patient had an uneventful postoperative course and was discharged from the hospital two days after surgery. On the fifth postoperative day the splints and sutures were removed. The pulps of the teeth were again tested and were found to be vital.

Nasopalatine duct cyst

PATHOLOGY REPORT—The pathological examination revealed an epithelial lined cyst consistent with nasopalatine duct cyst.

The gross specimen consisted of a membranous tissue fragment measuring 4 by 2 by 0.1 cm. The surfaces were gray-tan in color and showed focal areas of hemorrhage. One surface was smooth and glistening, and the other was dull, granular and rough in appearance.

The histologic examination of the section showed a cystic structure with a thin fibrous wall which was lined by a thin layer of stratified squamous, and in some areas cuboidal, cells. Fresh hemorrhage was present in the wall as well as focal aggregates of chronic inflammatory cells.

SUMMARY—A case of a large nasopalatine duct cyst has been reported in which the patient gave a history of at least two instances of trauma to the region.

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Hemangiopericytoma of the sublingual fossa: *report of a case*

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The hemangiopericytoma was first described by Stout and Murray[1] in 1942. They differentiated this neoplasm from the glomus tumor and other vascular neoplasms. By March 1955, Stout[2] had collected 197 cases in the surgical pathology laboratory of Columbia University. Most of the earlier cases involved lesions which were subcutaneous but a study of his and other material now shows a wide distribution throughout the body.[3] The hemangiopericytoma is not commonly encountered in the oral cavity, Stout[2] having listed 11 as having occurred in the oral cavity and pharynx. This is an incidence of about 5 per cent.

The characteristic cell of this tumor is the pericyte, a contractile element regulating the size of the capillary lumen, as described by Zimmermann in 1923[4] and called Rouget's cells by some pathologists.

CASE REPORT—The patient was a 57 year old Negro man who was first seen February 9, 1956, with the chief complaint of a large tumor beneath the left side of his tongue.

HISTORY—A pea-sized mass had been first noticed in the floor of the mouth on the left side, approximately three years previously. Its progressive increase in size resulted in difficulty in mastication and some speech alteration.

The patient had had yellow fever at the age of six. One episode of hemoptysis had occurred 15 years prior to his present appearance; the incident was investigated thoroughly but no cause was determined. The systemic review was negative except for a history of hypertension.

PHYSICAL EXAMINATION—The patient was a well-developed, well-nourished Negro man in no acute distress. A firm, movable, nontender, noninflammatory growth was noted in the floor of the mouth on the left side. The growth measured approximately 4 by 4 cm. (see illus-

Above left: Clinical view of sublingual tumor. Above right: Oat-shaped pericytes clustered about capillaries. Below left: Laidlaw's silver reticulin stain shows pericytes surrounded by delicate blackened reticulin fibers outside capillaries. Below right: High power view showing aggregations of rounded, oval and spindle-shaped cells lying outside endothelial-lined spaces

tration, above left). It extended from the midline posteriorly to the molar region. The tumor was oblong, and the surface was smooth. It did not involve the gingiva or mucosa overlying the edentulous posterior region. It occupied the whole of the left sublingual fossa. The patient's temperature was 98.6°F.; the pulse was 84, the respirations were 24, and the blood pressure was 220/110. Examination of the heart revealed a systolic murmur at the apex. The point of maximal impulse was located in the fifth intercostal space at the axillary line. Examination of the lungs disclosed bilateral rales at the bases.

LABORATORY DATA—The hemoglobin was 13 Gm. per hundred cubic centimeters; red blood cells were 4.5 million per cubic millimeter, white blood cells 11,800, with 60 per cent polymorphonuclear leukocytes, 2 per cent stab forms, 30 per cent lymphocytes, 6 per cent eosinophils, 1 per cent monocytes and 1 per cent basophils. The urinalysis showed that the specific gravity was 1.014 with a trace of albumin and an occasional red cell on microscopic examination. The Kahn test was negative.

ROENTGEN STUDIES—There was slight enlargement of the heart to the left. A generalized intensification of all bronchovascular markings was apparent. No areas of infiltration, consolidation, or pneumonitis were noted. The pleural spaces were clear.

SURGICAL REPORT—The patient was anesthetized with 2 per cent lidocaine with epinephrine. A linear incision was made over the most prominent portion of the sublingual tumor starting posteriorly and continuing to the anterior tip. With the use of sharp dissection, the margin of the mucosa was stripped from the capsule of the tumor. By means of blunt dissection, staying in the natural cleavage plane, the sublingual tumor was shelled out of its connective tissue bed. There was a stalk attaching the mass to the mylohyoid muscle, which was severed. The duct of the submaxillary gland was identified external to the tumor capsule and was dissected free. The lingual nerve was not identified. The anterior portion of the left submaxillary duct then was sutured to the mucous membrane, and the mucosa was approximated with interrupted no. 000 silk sutures. A Penrose drain was inserted into the operative defect and sutured to mucosa. The procedure was well tolerated, and the postsurgical course was uneventful.

PATHOLOGY REPORT—The specimen consisted of a spheroid mass of tissue weighing 22 Gm. and measuring 4.5 by 4.0 by 3.0 cm. The external surfaces were slightly lobulated and were a pale pink-yellow. A fine areolar connective tissue capsule was evident. The entire specimen was moderately soft to palpation. Serial sections disclosed a pink-gray to yellow-gray homogeneous appearance. A few zones of pale straw-color were slightly opaque.

The microscopic sections (see illustration, above right and below) revealed a definitely vascular new growth composed of great numbers of capillaries lined by normal endothelial cells. Whereas some channels were patent and contained red blood cells, others were collapsed and seen with considerable difficulty. In the more cellular areas of the tumor, the vascular channels were surrounded by spheroid or spindle-shaped pericytes showing no evidence of pleomorphism. These elements contained vesicular nuclei with a varying amount of eosinophilic cytoplasm with or without definite limiting membranes. These cells filled the spaces between and around capillaries, and formed the bulk of the tumor. Mitoses were absent. Laidlaw's silver reticulin stain and Masson's trichrome stains were used and revealed fine reticulin fibers but no fibrils. The reticulin fibers surrounded each cellular element.

In some parts of the tumor, the vascular channels were surrounded by a fibroblastic stroma in which collagen was identified.

DIAGNOSIS — The diagnosis was benign hemangiopericytoma. The report from the Mt. Carmel Mercy Hospital's division of laboratories was: "We feel that this tumor is a classic example of hemangiopericytoma. There is no suggestion of Kaposi's disease in which long spindle-shaped fibrosarcoma cells form the supporting substance of the vascular channels. Since phagocytes are absent, sclerosing hemangioma may be excluded. Further, since tumor cells do not line the capillaries, the diagnosis of hemangioendothelioma may be eliminated."

DISCUSSION — The histogenesis of this tumor is still considered obscure. Although Murray and others[5,6] demonstrated, by means of tissue culture, that the pericyte corresponded morphologically and physiologically with the epithelioid cell of the glomus tumor, Stout[2,7] considers that exact identification is contro-

versial. No evidence has been forthcoming to indicate whether the pericyte is fibrocytic or myocytic in derivation.

Two patients with prolonged pulmonary hypertension have developed small solitary lesions of the lungs that may represent a tumor of pericytes.[8] A similar growth has been encountered adjacent to the adrenal gland of a dog that had been subjected to induced hypertension.[9] The patient herein reported was known to be hypertensive. This suggests that the pericyte may be one of the cells stimulated under such conditions.

The anatomy of blood vessels aid in understanding the nature of the hemangiopericytoma.[10] The characteristic structure of blood vessels and the only component of the wall of the capillary is the endothelium. The capillary wall is composed of separate endothelial cells surrounded by a network of reticular fibers. This layer forms a thin sheath around capillaries and separates them from the elements of other tissues.

In the connective tissue which accompanies the capillaries, there are several types of cells, one being the pericyte. These cells, with long branching processes which surround the capillary wall, are contractile in character and are considered by some investigators to be of smooth muscle derivation, although lacking myofibrils. Since capillaries lack smooth muscle in the walls, these cells change the caliber of the lumen. This basic capillary unit is present in all tissue in which blood vessels are present.

The hemangiopericytoma is composed of capillaries surrounded by pericytes. The capillaries are simple endothelial-lined channels surrounded by a connective tissue reticulum sheath around which are grouped the pericytes. These cells vary in size and shape ranging from round to spindle forms. Between the pericytes there are connective tissue fibers in varying amounts. Occasionally the vessels with the surrounding tumor cells are separated from each other by a fibrous stroma, but more often they are so closely packed that the cells surrounding the vessel merge with those of the adjoining channels.[1]

The characteristic feature of a hemangiopericytoma is the location of the cells outside the capillary wall. This relationship is in contrast to that in the hemangioendothelioma in which the tumor cells lie within the capillary wall or lumen. The distinction may be difficult by ordinary stains but can be easily demonstrated by Laidlaw's silver reticulin stain. This stain shows the reticulin fibers in great detail, and the location of the tumor cells may be determined readily. The pericytes are surrounded by delicate blackened reticulin fibers outside the capillaries.[11]

The ordinary hemangiopericytoma may be differentiated from its best known variant, the glomus tumor, since it does not possess the characteristic organoid arrangement of the rich nervous complement. Further, the pericytes of the glomus tumor are always rounded in ordinary histologic preparations, whereas these elements may be elongated in the hemangiopericytoma. The glomus tumor is sometimes extremely painful and is limited in distribution to the superficial soft tissues, the terminal phalanx of the hand and the stomach. The hemangiopericytoma is distributed throughout the internal organs, tissues and bones in addition to the superficial soft tissues. The hemangiopericytoma usually infiltrates rather than being encapsulated, and in contrast to the glomus tumor, may metastasize. However, there are no definite histologic criteria for malignancy.[2, 12]

In most recorded cases the predominant complaint was an enlarging mass of long duration. Pain, when it occurred, was produced by pressure on a nerve trunk.[8] Stout found 21 per cent of all hemangiopericytomas to be malignant. Malignancy has been demonstrated by direct extension of the tumor to adjacent structures, recurrence after excision and metastases to regional lymph nodes, liver, lungs and bone.[3] There does not appear to be any important difference in incidence between the sexes, and all ages are affected, from birth to old age.

Diagnosis can be made only by histological examination. Wide surgical excision is indicated when a hemangiopericytoma is suspected. Radiation therapy has been helpful in three of

four cases in the literature, but there is no evidence for its use in primary treatment.[3]

SUMMARY—An unusual case of a hemangiopericytoma of the oral structure has been reported. Stout has encountered 11 instances in the oral and pharyngeal region out of 197. Twenty-one per cent have been malignant. Diagnosis is established only on histopathological examination. The tumors must be differentiated from the glomus tumor and the hemangioendothelioma. Treatment is adequate surgical excision. Hypertension may play a role in the etiology of this tumor.—*7411 Third Street.*

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Chronic desquamative gingivitis: *report of case*

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In the case of chronic desquamative gingivitis described herein, many factors were involved which contributed to confusion for both patient and dentist and made the diagnosis more difficult than usual. This case demonstrates that a patient can be "overtreated" if too many consultants are seen, none of whom is fully trained in stomatology.

REVIEW OF DISEASE—Only a brief description of the disease will be given here. Burket[1] or Goldman[2] may be consulted for complete details. This type of gingival involvement is somewhat uncommon and perhaps cannot be considered as a separate clinical entity but instead one of systemic origin arising from endocrine dysfunction or stress syndrome. It has been observed more frequently in women who are approaching the menopause, or who have irregular or difficult menses, but it has been observed in men.

The condition is chronic and appears as a diffuse inflammation of the gingiva with detachment of the epithelial tissues from the underlying connective tissues. The epithelial tissues can be removed easily from the involved regions and the underlying connective tissues are exposed. These then bleed from the slight-

est irritation. The buccal gingival tissues are the most common site, but the lingual tissues and the tongue may be involved as well. At times blisters appear which may contain a clear serouslike fluid, a yellowish purulent type of exudate, or a bloody material. In the case reported herein, some blisters contained a clear jellylike substance which has not been observed in previous patients. Desquamation will be present in one region whereas the remaining tissues show healing or normal appearance.

The tissue color varies from a purplish to a fiery red, and the underlying connective tissue may show a yellowish color with a white epithelial tissue overlying this. Pain at times is variable; it may be only a burning or itching sensation, or it may be severe enough to require analgesics.

Diagnosis is based on clinical examination accompanied by laboratory findings and the past history of the patient. The disease should be differentiated from oral pemphigus, stomatitis venenata, necrotizing ulcerative gingivitis, and hormonal disturbances associated with the gonads. Biopsy is important for assurance that no malignancy exists; blood studies and smears are inconclusive.

Treatments for the disease have been many and varied. There have been reports of the successful use of estradiol benzoate and ACTH and of an ointment containing high concentrations of vitamins A and D combined with an anesthetic agent. Hydrocortisone ointment has been used but not totally successfully. Successful treatment with estrogens and androgens has been reported.[3] A treatment plan must include reassurance for the patient and systemic therapy as indicated by other physical findings.

REPORT OF CASE—A white woman, aged 39, unmarried, was first seen February 4, 1957, having been referred by a dermatologist for what was thought to be an early pemphigus with oral manifestations only. The clinical examination showed this person to be well developed, slightly anxious, but with no apparent symptoms or signs of an acute illness. The oral mucosa in the mandibular molar regions was highly inflamed. This inflammation extended as far anteriorly as the cuspids. There was slight involvement of the upper molar regions. Some regions showed considerable vesiculation, with hemorrhagic regions and vesicles containing a clear jellylike substance. The gingival tissues were somewhat tender but not painful. There was no lymphadenopathy present, oral temperature was 99.0°F., pulse, respiration and blood pressure were within normal limits. The epithelial tissues could be pulled away from the underlying connective tissues without pain but with bleeding. The general condition of the mouth was average to slightly below. There was a maxillary prosthesis of chrome-cobalt alloy which replaced one anterior tooth. The prosthesis was below average in quality as were the existing restorations.

The patient stated that the oral condition had developed some two years previously after a return from a trip to Mexico. The condition had been acute but had healed after treatment and then recurred. It is felt that there was no correlation between the trip and the occurrence of the disease. On recurrence of the symptoms, the patient had been seen by her dentist, who prescribed some sort of an oxidizing agent but there was no improvement; in fact, the condition worsened somewhat. On the advice of her physician, she sought another dentist who treated her with chromic acid, but again the condition became worse. The third dentist treated her with what she thought was penicillin but she was not positive, since the treatment was of no benefit. A careful search revealed no change in cosmetics, drugs, mouth rinses, dentifrices or foods. The patient suffered no nasal or general symptoms to suggest an allergic phenomenon.

The patient's blood picture was considered by the internist to be in the normal range; however, there was an inversion of the polymorphonuclear leukocytes and the monocytes. A smear for fusospirochetal organisms was negative. Full-mouth roentgenograms could be examined, but there was no periodontal disturbance of importance, no caries, nor any evidence of other pathologic condition.

A tentative diagnosis of chronic desquamative gingivitis was made or a possible stomatitis

of viral origin. The patient was advised to use interdental massage with the finger tip and to use a mild medicated mouth rinse twice daily for one week.

The patient returned in a week but no improvement was noted so the mouth rinse was discontinued. A very mild sodium bicarbonate solution had been beneficial, the patient stated, so she was advised to use this after the massage. On March 22 she was referred back to the dermatologist who, at our request, placed her on cortisone administered systemically and locally. One week later the tissues were greatly improved, with only two small regions remaining.

On June 3, the gingivitis had recurred. The mouth was very tender, but not painful. The gingival tissues were highly inflamed which suggested the presence of an infectious process. The patient had no elevation of temperature, nor physical signs of an acute illness. Smears were negative. Through June and July no improvement was noted, but the condition did not worsen.

On October 10 the patient returned because she was concerned a malignancy might be present. To dispel her fears, a biopsy specimen of the tissue was taken. The microscopic examination showed areas of extensive fibrosis and other areas of extensive inflammatory reaction. There was no evidence of malignancy except in one small region and this was only suggestive since a few atypical cells were observed and the pathologist did not feel that these were significant. His suggestion was that the regions of granulation tissue be removed if possible. This was not thought feasible, therefore no tissue was removed.

On October 12, the patient developed severe pain in the region of the upper right molar and the tooth had to be extracted. On October 14, hemorrhaging developed distal to the extraction site and it was necessary to resort to electrocautery for control. Healing was then uneventful.

On November 7, the patient was seen by the director of the dental school of a nearby university. His opinion was that this was chronic desquamative gingivitis and suggested that another biopsy be taken of the tissue from the upper molar region. This revealed nothing, nor did a tissue study for viral inclusion bodies.

The patient then consulted a former employer, a proctologist, who suggested that she go to the Mayo Clinic. Arrangements were made and our report was forwarded to the dental department.

A report from Stanley A. Lovestedt stated that this was "a desquamative stomatitis or gingivitis type of lesion." He stated further that "it has been our experience in these cases that these people might often have been overtreated, because of going from one person to another seeking relief."[4]

The patient was seen after her return and it was suggested that she again consult the internist. He did not elect to use estrogens or androgens, but recommended that she remain under our observation. We did not see her again, but in December 1958, a periodontist called to check our findings. He reassured the patient and dismissed her.

COMMENT—In the case reported herein, it is definitely demonstrated that a patient with this condition should be treated correctly and that a correct diagnosis is essential prior to any type of treatment. Such conditions present difficulties chiefly because of the patient's anxiety. These patients should be treated for the anxiety primarily and the oral lesions secondarily. Since the condition is undoubtedly systemic, it should be treated by the physician after diagnosis by the stomatologist.—*1709 Randolph Avenue.*

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Posttraumatic cervical pain syndrome: *report of case*

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Pain associated with the jaws usually is of dental origin. The cause of such pain generally is easily recognized and treated. Irritation of peripheral nerves in pulp, periodontal membrane or surrounding structures usually is involved. In head pain the clinician must consider other implicating factors, such as organic and psychosomatic central nervous system disturbances, irritations of nerve roots and of nerve endings in muscles, tendons and ligaments. At times, the cause of pain is not determined easily, especially when the pain is referred in character. In differential diagnosis of lower face pain, one anatomic region often overlooked is the cervical plexus. Yet this plexus contributes cutaneous nerves to the skin over the angle and ramus of the mandible. Injury to the cervical nerve roots from a variety of traumatic causes has been described.[1-5] The cervical nerve roots, therefore, must also be included as a possible cause of facial pain.

REPORT OF CASE—The patient, a 43 year old Negro man, complained of pain in the lower left side of the jaw which he thought was dental in origin. It was dull and not sharply localized, continual with periods of remission, and was unchanged by hot or cold liquids. There was intensification of pain with right lateral rotation and flexion of the head. The pain had been present for eight months, during which time the patient took four or five aspirin tablets a day for relief. Upon further questioning, he stated that concomitant with the jaw pain, there was a dull ache, numbness and weakness of the entire left arm.

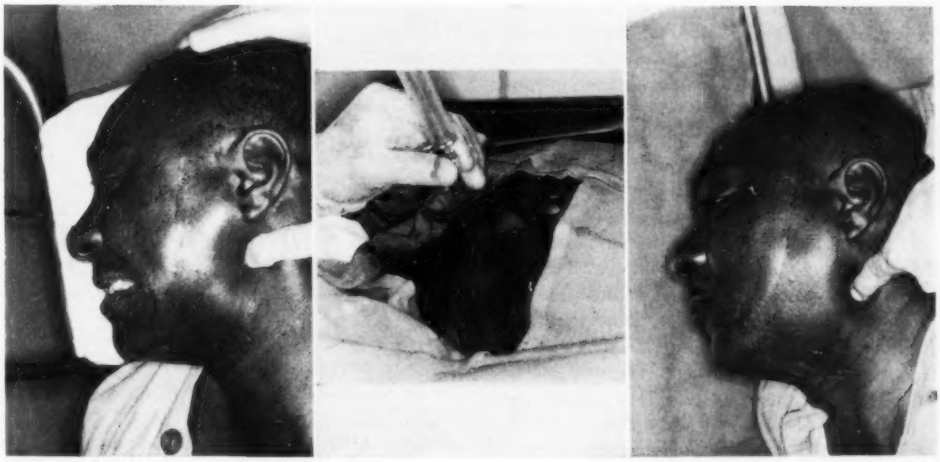
PAST HISTORY—The patient had been in the hospital eight months before because of emphysema. There was some degree of paralysis of his inspiratory muscles. Along with the other treatment, he had been placed in a respirator for three days. He was treated successfully, and was discharged in one month.

PHYSICAL EXAMINATION—On the last hospital in-patient admission the patient was a well-developed, heavy-set man, six feet tall and weighing 220 pounds. His collar size was 17. At the time he came for the present treatment at the out-patient department, he was a well compensated cardiac patient and was on digitalis therapy with little limitation of daily activity. Examination of his face revealed a vertical scar on the left cheek which the patient stated had resulted from an auto accident several years ago. Upon right lateral rotation and flexion of the head there was intense, diffuse pain in the right side of the jaw posteriorly. Intraorally, there was no dental cause which would account for this pain. Palpation of the muscles of mastication elicited no abnormal response. Palpation of the brachial plexus also elicited no abnormal response. The transverse processes of the cervical vertebrae were then palpated. Pressure on the second cervical vertebra caused severe pain along the left side of the mandible and the side of the face. Concomitant with this pain, there was a dull ache and weakness in the left arm and hand (illustration, left).

TREATMENT AND CLINICAL COURSE—A left cervical block at the level of the second and third cervical vertebrae was performed by the anesthesiologist. Five cc. of 1.5 per cent lidocaine hydrochloride with epinephrine 1:150,000 was injected at the left transverse

process of the second and third vertebrae, using 22 gauge, 3½ inch spinal needles (illustration, center). The patient experienced anesthesia of the skin of the angle of the mandible and of the auricle. He was free from pain on lateral rotation and flexion of the head and even with digital pressure on the trigger area (illustration, right). The patient reported that the anesthesia lasted more than six hours, until he fell asleep that night. In three days the strength in his left arm had returned to normal. The present freedom from pain and equality of strength in both arms have remained unchanged to date.

DIFFERENTIAL DIAGNOSIS—In the differential diagnosis of pain of the head and neck, the possible causes are many and varied. The resulting pain from any one of these causes can be either localized to the point of noxious stimulus, can be diffuse, or can be referred to a different region entirely. The clinician can, however, correlate his knowledge of anatomy and physiology with the signs and symptoms to narrow down the possible causes to a very few, perhaps one or two. The positive signs and symptoms must be used to point toward the likely diagnosis. Negative signs and symptoms will rule out certain of the possible diagnoses. It is not the purpose of this paper to review all the possible causes of head pain. The reader will, however, find several excellent reviews in the literature.[3-11] In the case reported, there were a few theories as to etiology. The teeth and jaws, being the most common cause of lower face pain, were first ruled out. In view of the patient's cardiac history, and his left arm symptoms, a bizarre form of anginal pain was considered.[6, 9, 12, 13] Pain on the basis of a vascular disturbance was another possibility.[5, 14-19] Neuromuscular (including tendons and ligaments) pain on a traumatic basis was also suggested.[1-5] This last likelihood was confirmed by pressure on the second cervical vertebra and by the history of the patient having been in a respirator for three days. In the respirator used, the patient is placed inside with his head outside. A circular disk of firm, sponge rubber with a small central opening assures a secure fit around the patient's neck. This provides an air-tight mechanism so that the alternating pressure within the respirator increases and decreases the pressure on the patient's thorax. In the case reported, this was a life-saving measure. The rubber disk fits snugly



Left: Pressure applied to region of second cervical nerve root causing radiating facial pain. Center: Local anesthetic block of second and third cervical nerve roots. Right: Postanesthesia freedom from pain

around an average size neck. This patient, however, was a larger than average man and had a size 17 neck. Thus, excessive pressure could easily have been put on the second cervical nerve root itself, or on the tendons or interspinous ligaments of that region.

ANATOMY—The fifth cranial nerve supplies most of the sensory innervation of the face. However, the greater auricular nerve, which arises from the second and third cervical nerves, supplies the skin over the parotid gland and immediately anterior to it, and occasionally extends almost to the corner of the mouth.[13,20,21] The cervical cutaneous nerve (cutaneous coli), also arising from the second and third cervical nerves, sometimes supplies the anterior mandible, anterior lower teeth, and lower lip.[22,23] Also, in the blood vessels of the face there are pain fibers which travel down the cervical sympathetic chain to the thoracic sympathetic ganglia and enter the spinal cord at that level carrying pain sensation to the higher centers.[4,5,15]

PHYSIOLOGY—THE VICIOUS CYCLE—When muscles, nerves, tendons or ligaments are injured, nerve impulses are initiated, and reflex responses are set into action. Afferent (sensory) impulses from the point of injury travel to the central nervous system. There, these impulses cross internuncial neurons to efferent (motor) neurons of both somatic and autonomic nervous systems. These efferent impulses cause muscle and vasomotor spasms and result in vascular inflammatory changes in the region near the original injury. These muscular and vascular changes not only sustain the original inflammation but are themselves new sources of pain. A self-perpetuating cycle is thus established: First, the original injury reflexly causes nearby muscular and vascular disturbances. Then, these changes aggravate and prolong this original injury. This is a vicious cycle.[1,4,24-26] The proof of this theory is found in experiences common to physicians and athletes (usually amateur). If a sprained ankle, within a short time after its occurrence, is infiltrated with procaine, disability and pain will be controlled or at least diminished, and healing will be much more rapid.[26] The physiological mechanism is one of interrupting the vicious cycle. The noxious locus is thus prevented from initiating injurious reflexes.

TREATMENT—It is in this commonly employed treatment that the therapy for posttraumatic neuralgia is found; that is, the injection of local anesthetic solution at the point of greatest tenderness—the original injury site.[4,6,24,26-28] Thus, the reflex nervous pathway is interrupted and the vicious cycle is broken. The relief from pain can be expected to last for weeks, months, or permanently.[4,24] The infiltration or blocking of peripheral nerves at the apparent site of pain rather than at the original site of injury will give only transient anesthesia. The injection of a local anesthetic solution at the original injury site only can be expected to break the vicious cycle permanently.

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Malignant giant cell tumor of the mandible: *report of case*

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The exception which proves the rule may take the form of tragedy for the individual patient. Statistical evidence lacks its comforting wisdom when the surgeon is confronted with biologic phenomena in an instance which does not conform to recognized patterns.

The enigma of the giant cell tumor of bone has brought questions of diagnosis and treatment for more than a century. Fibro-osseous abnormalities are complex but none presents a greater problem in interpretation and therapy than the giant cell tumor. Contradictory fundamental opinions are witnessed by the historic nomenclature. Terms such as "myeloid sarcoma," "chronic hemorrhagic osteomyelitis," and "giant cell sarcoma" are to be found. Debate concerning characteristics of reactive inflammatory repair processes or true neoplasm with benign or malignant potential abounds in the reports and reviews in the literature. When the concept of neoplasm for most skeletal giant cell lesions became accepted, the problem of behavior and therapy remained. Virchow "fully recognized the benign course of giant cell tumors of the jaw but agreed that the lesion in the long bones might be malignant and metastasize."[1] Reviews of both the malignant and benign course of giant cell tumor in the long bones deplore "the apparent impossibility of separating innocent from malignant variants except by their clinical course."[2] In the epiphysis region of long bones and commonly around the knee area, 10 to 15 per cent of these lesions are malignant. Jaffe, Lichtenstein, Stout, Ackerman[3-6] and other authorities on bone neoplasia have sought criteria for diagnosis. The first accomplishment was the exclusion of other fibro-osseous lesions such as fibrous dysplasia, aneurysmal bone cyst, osteitis fibrosa cystica, and osteogenic sarcoma. This limited the considerations and brought the true giant cell tumor into sharper focus. Attention to stroma pleomorphism, cellularity, and numbers of mytotic figures developed a spectrum of malignant potential. In spite of these improved criteria, authorities still caution that "occasionally a tumor which looks benign histologically may invade vessels and metastasize."

In the jaw region, the giant cell lesion has a similar complexity but the probabilities of benign behavior appear increased. Jaw lesions have been excluded from most discussions of the lesion in other parts of the skeleton. Jaffe[3] coined the term "reparative giant cell granu-

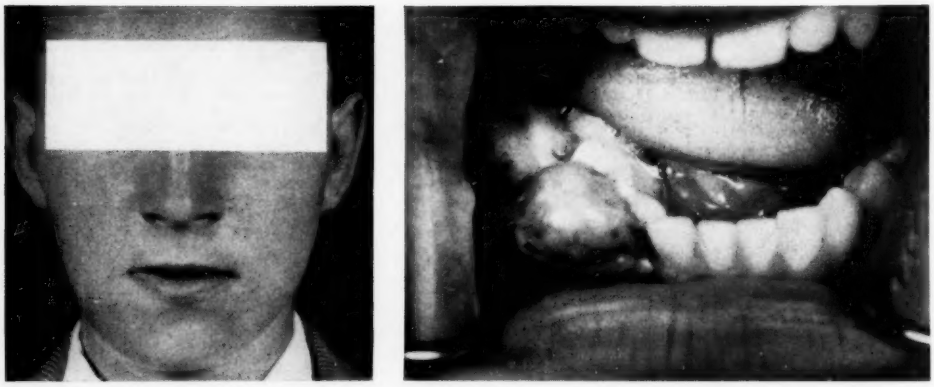

Fig. 1—Left: Slight swelling over right body of mandible, May 1957. Right: Intraoral tumor mass, May 1957

loma" to describe most jaw lesions on a reactive blastomatoid basis. He further stated that the true giant cell tumor in the jaws is extremely rare.

In pointing out the difference between jaw lesions and long bone lesions, Waldron[7] pointed out the distinct difference in the patient's age when the tumor is diagnosed. Long bone lesions rarely occur before a patient is 20 years of age and the jaw lesions rarely after he is 20 years old. Waldron[7] further states that in reviewing the literature concerning giant cell tumor of the jaws he has found no recorded instance of malignant behavior. He indicated the prevailing opinion that giant cell lesions of jaws offer a very good prognosis.

The tendency for persistence or recurrence after treatment of both the peripheral epulis and central forms of giant cell tumors of the jaws has long been recognized. The association of the lesion with relative degrees of connective tissue maturity, and all the laws of metabolic and endocrine influence, suggest a significant relationship with the age group of the puberty period. Some recurring giant cell lesions in the jaws are thought to "burn themselves out" when a balance of hormonal influences stabilize and the over-zealous repair process conforms to more normal patterns.

These problems are illustrated with graphic evidence in the case that is reported herein.

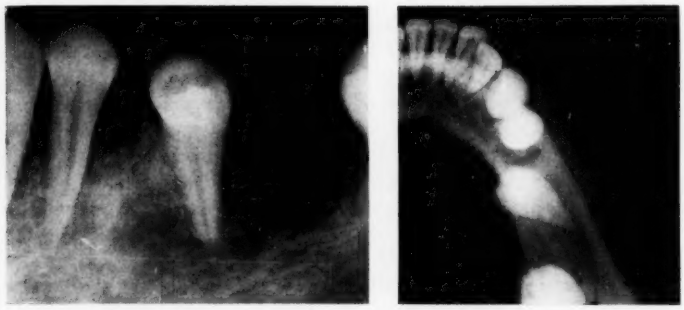

Fig. 2—Left: Destruction of alveolar process in first molar region. Right: Occlusal projection suggesting proliferation over lateral cortical plate

REPORT OF CASE—A 14 year old school boy received a blow to the right side of the mandible in late August of 1956. After this trauma, soreness developed in the right mandibular first molar region. This tooth was extracted and it was noted two weeks later that a "pea sized lump" protruded from the extraction site. Two months after the extraction a specimen of the mass was taken for biopsy. The pathologist report at that time was "fibrous dysplasia." On the return of the tumor mass at the crest of the alveolar ridge, a local excision was carried out in February 1957 by an oral surgeon in the patient's community. Healing was reported to be satisfactory one week after the excision. The pathology report was "peripheral giant cell tumor." The local excision had extended to the level of the inferior alveolar canal. When the tumor mass recurred the patient was referred to University Hospital on May 9, 1957 (Fig. 1). Slight facial asymmetry had been produced by the expansion of the tumor with swelling over the right body of the mandible. Intraorally a soft tissue mass obliterated the right lower vestibular area with involvement of the gingiva from the second molar to the first bicuspid region. The expansion was greater on the buccal than on the lingual aspect. The tumor bled freely on slight manipulation. Anesthesia of the right inferior alveolar nerve had been present since the local excision procedure in February. Roentgenograms of the region indicated a destructive and proliferative process (Fig. 2). A preliminary biopsy was reported "peripheral giant cell tumor or epulis."

The patient was admitted to the hospital for a complete review of history and physical examination. The results were entirely negative. The patient's weight, which had been stable, was 130 pounds. All roentgenograms of the chest and skeletal survey were negative except for the defect in the right side of the mandible. Routine laboratory studies were all within normal limits. Serum calcium, phosphorus, and alkaline phosphatase were also reported as normal. The patient was taken to the operating room on May 14, and the tumor mass was excised locally by wide intraoral and extraoral approach. A cortical defect was found laterally after the exposure through the extraoral dissection. It was felt that wide margins had been obtained and the procedure was relatively uncomplicated. The pathology report on the specimen was "moderately cellular peripheral giant cell tumor. No conclusive evidence of malignancy." The patient was discharged after a hospital course of four days and the initial healing was satisfactory.

The patient returned to the hospital two weeks later when an extensive recurrence was evident (Fig. 3, above). A biopsy specimen of the recurrence on May 27 was reported as "moderately cellular so-called giant cell tumor or epulis." The patient was seen in Tumor Conference on May 29, and it was recommended that in view of the apparent rapidity of recurrence, a trial of radiation therapy should be attempted to control the tumor growth. In the course of the next week the patient received 1,500 r to the right side of the mandible. The tumor continued to grow rapidly in spite of the radiation and only minor changes were noted in the surface tissues (Fig. 3, below).

Meanwhile the slides of the various biopsies and excision specimens were circulated to consultant authorities in pathology. The lesion was interpreted to be cellular and producing cartilage, osteoid, and bone with the presence of osteoclastic giant cells. The diagnosis was "benign osteoblastoma." Some concern was expressed regarding the cellularity and rapidity of recurrence. Wide local excision was recommended.

According to the interpretation of current status on June 11, the visible tumor mass was excised with what were considered to be adequate margins. These crossed the midline of the mandible and proceeded to the retromolar region on the right. Healing again was uncomplicated and the patient was discharged. He was followed on periodic out-patient evaluation visits on June 26, July 9 and July 18. On July 22 there appeared to be evidence of recurrence at the poles of the intraoral defect (Fig. 4) and evidence of pathologic fracture was noted over the area of the right side of the mandible. The biopsy specimen of the recurrent tumor was again reported as "benign osteoblastoma." At this time the patient had experienced a nine pound weight loss over a

Fig. 3—Above: Recurrent tumor mass two weeks after excision. Below: Enlarging tumor mass after trial of radiation therapy

two month period and was in considerable pain and had difficulty in sleeping.

In view of the additional recurrence, presentation at a tumor conference brought a recommendation of wide resection of the entire mandible and the adjacent soft tissues. On August 15, the right side of the mandible was resected from the base of the condyle on the right to the mental foramen region on the left by a joint team of surgeons. A threaded Kirschner wire was placed across the span in an effort to reduce deviation of the remaining left mandibular segment (Fig. 5). An elective tracheotomy was performed at this time. The clinical margins of the excision appeared very adequate with no neoplastic involvement in the tissue margins of the specimen. The pathology report was "osteoblastoma with reactive new bone formation. There appeared to be neoplastic cells involving vascular spaces. The submaxillary gland and regional lymph nodes are not involved by neoplasm." Again the course was satisfactory postoperatively and the patient was discharged on August 22.

Out-patient visits on September 4 and September 21 indicated an evidence of recurrence. A sudden development of swelling in the chin area suggested the possibility of secondary infection and the wire became exposed necessitating its removal (Fig. 6, left). This was accomplished on November 7. On December 21, it was evident that a large recurrence of the tumor

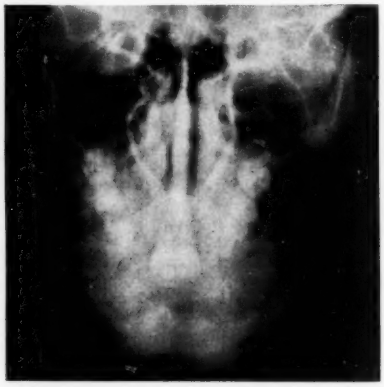

Fig. 4—Left: Recurrent tumor mass at left bicuspid region. Right: Destruction of right side of mandible with pathologic fracture

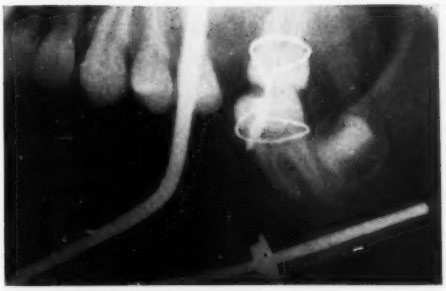

Fig. 5—Above: Partial mandibulectomy from left molar region to base of right condyle: Below: Threaded Kirschner wire junction

had involved the right infratemporal fossa. Routine chest roentgenograms up until this time had failed to indicate any evidence of metastatic disease. However, in January 1958 there was definite evidence of metastatic involvement in the lung on the basis of roentgenographic diagnosis (Fig. 6, center). The patient was managed on an out-patient basis with increasing requirements of analgesics and progressive weight loss. On November 13, 1957, a gasserian ganglion alcohol block of the right trigeminal nerve had been performed which gave partial relief. Several chemotherapeutic drugs were used in palliative effort. The problems of pain and nutrition became increasingly difficult. On February 11, 1958, the patient was again admitted to the hospital for a bilateral frontal leukotomy in an effort to control his pain (Fig. 6, right). The results of this palliative procedure were slightly beneficial. The patient returned to his home where nursing care was improvised until his death on April 12, 1958.

COMMENT—This tragic course of a neoplasm in which the pathologic diagnosis indicated that it continued to have benign histopathologic characteristics and yet there was

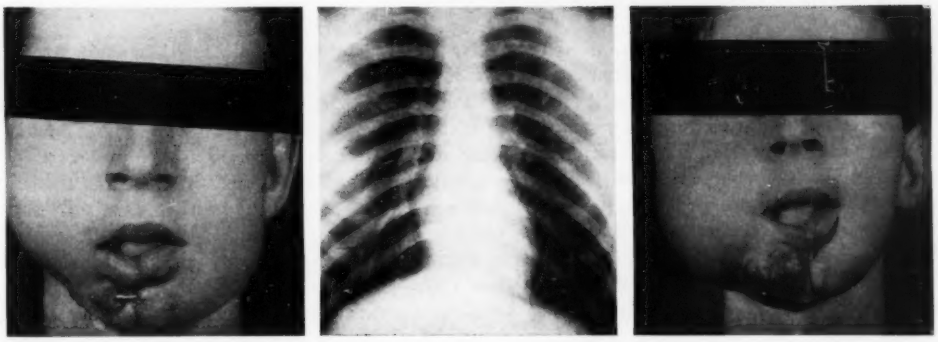

Fig. 6—Left: Recurrent tumor mass in right cheek and infratemporal fossa and in area of pin exposure. Center: Pulmonary metastatic nodules most evident in right lung field base. Right: Massive tumor appearance shortly before terminal episode April 1958

a clinical course of frank and aggressive malignancy should stimulate the clinician and the pathologist to greater respect for the fibro-osseous lesions designated as giant cell tumor.

Speculation regarding effects of repeated attacks in the possible conversion of a benign process to malignancy must be acknowledged in this tragedy. The clinical course was a classical example of a highly malignant order of neoplasm. The histopathologic diagnosis and the known tendency for benign giant cell tumors to recur were unfortunate reassurances in the management of this problem. Until additional criteria are in evidence oral surgeons will have difficulty in making proper decisions as to the degree of radical treatment which may be required for the giant cell tumor.

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■ Gifted Students and Educational Systems

American educational systems, by overemphasizing the "well-rounded all-American youth," may be discouraging some of the most gifted students. If an especially bright student does not seem to fit into the "round mould," perhaps the educators should let him have a few "sharp edges." Current dangers of our entire educational system consist in the tendency to reward conformity and in the routine practice to place a high premium on the student usually described as the well-rounded American youth. For those students, however, who have special abilities, interests and ample energy, there exists no reason why they should not be encouraged by educators to be themselves. The following recommendations for changing the educational system are made: (1) a solid four-year high school study of the academic subjects—English, sciences, mathematics, modern foreign languages; (2) a grouping of students in classes according to their abilities and interests; (3) a rigorous counseling program with guidance based on aptitude and intelligence tests and on the school records; (4) an advanced program to permit talented students to enter college with credits toward graduation already established, and (5) an advanced study program for talented students on a lower grade level making available ninth-grade subjects to superior students in the eighth grade.—*National Education Association, Report of December 1958.*

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The other side of the coin

ORAL SURGEONS have heard much about the necessity for "over-all quality of patient care" and it must be admitted that in the past practitioners of medicine had some good reason for their position. A thorough examination of the problem during more recent years, however, does not substantiate this attitude. In our opinion, which I am certain is shared by most oral surgeons today, the "shoe is on the other foot." The record of the well-trained oral surgeons is indeed a good one, and in the vast majority of instances, the operative results obtained by this group are excellent.

When the other side of the coin is examined, we find to our disillusionment and to the patient's sorrow that medical surgeons, operating without a formal background in oral surgery, have a distressingly high frequency of poor operative results—results that by all standards are not acceptable to the well-trained oral surgeon. The cause is obvious immediately. It is the result of some men in the medical specialties assuming responsibility for the treatment of certain oral conditions despite the fact that they are unprepared by training or experience to assume such responsibility. Their most dramatic and frequent mistake is in the management of facial fractures. Since few physicians have had any educational preparation in the anatomy or physiology of the oral-masticatory mechanism, they too frequently disregard or misinterpret the function of occlusion and its importance in the management of fractures. This, of course, produces tragically inadequate results. Dentists are repeatedly asked postoperatively to "adjust the occlusion" or to "construct a prosthesis" to complete the rehabilitation of the patient.

Certainly the time has come for oral surgery to turn the coin over and to present its other side with vigor and imagination. An examination of the mass of certified records of such tragic cases would present convincing and powerful support of the need for the specialty of oral surgery in the proper care of the public. We know that we have much to offer to total care but we have been willing to hide our light under a basket for too long. The time has come to reveal it. A well-planned, well-financed public relations program will do much to correct this long-standing inaccuracy. We cannot afford to delay it or to put forth a partial effort, for the hour is late. It must be an all-out effort and the time is now.—*Fred A. Henny.*

■ Tranquilizers as Premedication for Dental Patients

Q.—Are there any advantages in using one of the tranquilizers as premedication before dental treatment?

A.—In the past several years a number of tranquilizers (ataraxics) have been placed on the market and they are, as a group, supposed to produce a sense of well being without diminishing mental acuity. These drugs have been used successfully in the treatment of a variety of mental illnesses but their effectiveness in the normal person is still in doubt. For premedication of the dental patient a drug should be relatively short acting and should not produce mental depression or any degree of significant side effects. The full effect of the drug, ideally, should be after a single administration.

Though the tranquilizers do not generally meet the foregoing requirements for ideal dental premedication, they do have a place in dentistry and, more particularly, oral surgery. These drugs have a sedative effect in varying degrees depending on the drug used and the dosage. They also produce, more in some patients than in others, a sense of well being. They have the proved ability of potentiating narcotics and barbiturates.

It is the sedative effect and the potentiation of other drugs that make these agents useful. Trifluprom azine (Vesprin), one of the newer psychotherapeutic agents, has been found to have a greater tranquilizing potency than chlorpromazine hydrochloride, and causes fewer undesirable complications. Used as a sedative prior to surgery under local anesthesia, the drug proved to be most effective. When given in small doses, intravenously, a light sleep was produced in the majority of patients. The patients proved cooperative and a distinct improvement was noted in their response to the emotional stress of the situation. Postoperative recovery was rapid and no complications, such as circulatory depression, were noted.

Reports indicate the superiority of this drug over other tranquilizers in preventing or treating emesis of all types and for potentiating the effects of general anesthetics.

■ Replantation of Evulsed Teeth

Q.—What procedures should be followed in the treatment of an evulsed maxillary incisor if replantation is to be attempted?

A.—With the advent of antibiotics and better supportive measures, the incidence of successful replantation has steadily increased. People have, through newspapers and periodicals, become aware of the chances of preserving teeth which have been lost because of trauma. They often retrieve the lost teeth, and in a number of instances the teeth can be replaced.

Various technics are suggested, but the following basic principles must be adhered to:

1. The tooth must be cleansed of all debris as soon as possible. This generally can be accomplished by washing the tooth gently in sterile, normal saline. Some advocate the use of an antibiotic solution.

2. The root canal is then prepared in the usual manner with a great degree of caution regarding complete curettement and sterility.

3. Several millimeters of the apex should then be excised with a bur and the end treated with a hot spatula. Some operators do not advocate the excision of a portion of the root, but the procedure seems indicated since the resultant socket space provides a reservoir for tissue fluid. Because of this, no back pressure is built up and the tooth is not pushed from its socket.

4. The socket is cleansed gently and unattached small pieces of alveolar bone are removed. Heavy curettement is contraindicated.

5. The tooth is then put in the socket and held in place with wire ligatures or an acrylic splint. The latter method has proved most convenient and efficient, particularly since the development of new self-curing acrylic resins. It has also been advocated that the tooth be positioned a little above the incisal plane, as this allows eruption of the tooth because of back pressure. If it is held in place properly it should not erupt.

The success or failure of replantation does not necessarily depend on the technic employed. Though standard and accepted procedures may be employed, the result may still be unsuccessful because of root resorption. Why this occurs in some instances and not in others is not clearly understood. Instances of root resorption after replantation have been retreated by an apicoectomy, removing the granulation tissue and freshening the apical region. This approach has, in some instances, arrested the resorption process.

■ Topical Use of Penicillin

Q.—Are there any indications for the topical use of penicillin in dentistry?

A.—There has been much discussion concerning this topic. A review of the literature, and clinical experience support the view that the topical application of penicillin is never indicated. When indicated, penicillin is much more effective when given systemically. The disadvantages of topically applied penicillin as compared to systemic administration are: limited penetration, a greater danger of sensitization, and a greater tendency toward production of local inflammatory reactions.

The problem of sensitization is perhaps the most important and should be viewed with some alarm. The incidence of acute penicillin reactions is increasing, and the patient should not be jeopardized. There is a general feeling that antibiotics which may be given systemically should not be used topically in the oral cavity because of the chance of sensitization complications. Numerous preparations of the more insoluble drugs which are generally not given systemically are available and have been found to be most effective. These include polymyxin, bacitracin, neomycin and tyrothricin, and they are available in various combinations.

■ Penicillin Substitutes for Allergic Patients

Q.—If a patient has a history of rheumatic fever or rheumatic heart disease or both, and also is sensitive to penicillin, which of the other antibiotics should be used to provide adequate coverage after a surgical procedure?

A.—Except for penicillin, erythromycin is perhaps the most specific for the control of infection arising from organisms contained in the oral flora. Erythromycin is indicated in the treatment of pneumococcic, staphylococcic and streptococcic infections, particularly in patients who are sensitive to other antibiotics and for infections in which the causative organisms are resistant to other antibiotics which are more generally used because of their wide spectrum attributes.

Some authorities recommend the use of dihydrostreptomycin in order to combat the enterococci in the oral flora. The newer sulfa combinations, which have a low incidence of side reactions, are also being recommended when the patient is sensitive to penicillin.

This section devoted to queries and comments from readers on topics of current interest to oral surgeons and general dental practitioners is edited by S. Elmer Bear, Department of Oral Surgery, Medical College of Virginia, Richmond, Va., to whom readers are invited to send their communications. The answers, prepared by competent consultants, do not necessarily represent the opinions of any official scientific organization. Your participation in this section is invited.
THE EDITOR

■ Periapical pathosis in teeth which are in direct relation to the maxillary sinus need not exclude them as candidates for a root resection. No untoward sequelae have been observed in instances in which the sinus has been exposed by the surgical procedure. In an effort to save key teeth in the arch, it may be necessary to invade the sinus when excising the apical lesions from multirooted teeth. It has been interesting to note the number of times the infectious processes have actually destroyed bone and sinus membrane thereby providing direct visualization of the sinus when the granuloma has been curetted from its bed. Based on this observation, the low incidence of chronic sinusitis resulting from infected teeth is surprising.

The primary precaution which must be observed when invasion of the sinus is anticipated is the position of the flap. It is better to make a larger flap with a gentler arch in order to assure an adequate bone base when the flap is repositioned. The rationale for this is the same as that when the sinus is invaded for any other reason. Postoperative antibiotics and nose drops should be used routinely.

■ Major changes may be made in the field of antibiotics in the not too distant future. Four British scientists who work for Beecham Research Laboratories have achieved a total synthesis of the basic substance of penicillin, 2-amino penicillic acid. The substance is regarded as the common parent acid of the five natural forms of penicillin.

Lederle Laboratories has also isolated a synthetic tetracycline which has biological activity.

These developments may permit the production of countless antibiotics which cannot now be made of the living organisms. This may provide a means of eliminating the increasing resistance of microorganisms to the present antibiotics and may also overcome host sensitivities.

Professor Ernest B. Chain, winner of the Nobel Prize for his work in the field of antibiotics, said the development of synthetic penicillin could lead the way to "the most important breakthrough in the penicillin field since the discovery of penicillin's curative power."

Readers are invited to send their clinical observations to S. Elmer Bear, Department of Oral Surgery, Medical College of Virginia, Richmond, Va.

■ FUNDAMENTALS OF GENERAL ANESTHESIA FOR STUDENTS AND PRACTITIONERS OF DENTISTRY. By John Adriani. 200 pages with illustrations. Index. $6.50. Springfield, Ill., Charles C Thomas Co., 1959.

Dr. Adriani's book supplies in a general way practically everything one would need to know about general anesthesia for dental procedures. In fact, most subjects are covered in enough detail so that a dental practitioner would seldom need to explore beyond their depths the specific literature of anesthesiology. It therefore supplies what such a book may be asked to supply. What it does not furnish is, of course, the clinical experience of anesthesia, but the author emphasizes (as who, these days, does not?) that any general anesthetic is a major undertaking not to be embarked upon lightly.

The pharmacology of the commonly employed anesthetic agents, the physiology of their action and elimination, their indications, their hazards and complications, are all covered in an efficient way. The technics and mechanical devices for their administration are described and illustrated with diagrams and pictures. The style is terse.—*Sam Houston Brock, Jr.*

■ HANDBOOK OF DENTAL PRACTICE. Edited by Louis I. Grossman, D.D.S. Third edition. 515 pages with 514 illustrations. Index. $14. Philadelphia, J. B. Lippincott Co., 1958.

In the brief span of ten years this book has appeared in a third edition. This is an indication that past editions have been so well received by the dental profession as to warrant a new printing, bringing older material up to date and reviewing much that is new in the various fields of dental practice. The efforts of a number of new and highly competent authors have been enlisted to extend the coverage of this edition to include all major phases of modern dental practice.

The book is divided into two parts. The first part, entitled "Diagnosis and Treatment," contains two chapters devoted to the cause, prevention and control of dental caries. These chapters are worthy of review by all members of the dental profession without exception. A highly commendable effort has been made therein to gather, correlate, and evaluate all available information on this most vital subject.

With the exception of the chapters concerned with dental caries, endodontics, and periodontics, little new information is presented on such topics as roentgenology, oral diagnosis, oral disease, and exodontics. The chapter on orthodontics, although containing numerous interesting facts and observations, most certainly will tend to discourage any but the most intrepid general practitioner from an occasional venture into this field.

The second part of the book is devoted to restorative dentistry in all its phases. Particularly outstanding is the chapter on amalgam, silicate, and direct resin restorations. A review of this chapter is recommended unconditionally for all dentists engaged in general practice. The remaining chapters on such subjects as partial dentures, complete dentures, pedodontics, crown and bridge, and so forth, are well written and contain much information of value to the general practitioner.

References are supplied with only ten of the 19 chapters composing this book. In the interest of completeness, and for the benefit of those readers who would be interested in pursuing a topic further, this is a fault which should be corrected in future editions.

There are few faults to be found with the text as it is well organized, profusely illustrated, and accomplishes its main purpose of providing an excellent source for review of all phases of dentistry. In this respect, it is of value to the

general practitioner, and to the specialist who desires to keep up to date and well informed on all phases of modern dentistry.—*Edward P. Henefer.*

■ OSTEORADIONECROSIS OF THE JAWS. By Irving Meyer, D.M.D., D.Sc. 51 pages with illustrations. $1.75. Chicago, The Year Book Publishers, Inc., 1958.

This short monograph, originally a thesis by the author for the degree of Doctor of Science, presents in a logical and concise manner the multiple problems of osteoradionecrosis of the jaw. The opening pages scan the early and more recent literature on the subject including the effect of radiation on developing teeth and jaws, and there is a brief but excellent discussion of the pathological bone changes produced by radiation with particular emphasis on the damage to the osseous blood supply.

The major portion of the monograph relates the author's experience with 491 patients with cancer of the oral cavity for which the primary mode of treatment was radiation: in some cases surgery was employed secondarily. Of this number some 27 patients, or 5 per cent, developed osteoradionecrosis with its unmistakable developing signs and symptoms.

In a distinct step-by-step presentation of treatment of osteoradionecrosis, from simple debridement and irrigation through sequestrectomy with saucerization, various forms of therapy including electrocoagulation, neurosurgery, and intraoral and extraoral jaw resection are examined with explanations for undertaking one procedure in preference to another. This section is well documented with line drawings illustrating the surgical procedures. The photographic illustrations of several cases are well chosen and accomplish their purpose.

The subject of prevention is briefly reviewed and it is gratifying to read of someone advocating a definitive attempt to prevent osteoradionecrosis by extracting all the teeth in the line of anticipated radiation followed by a radical alveolectomy. Too often in the past, authors have been afraid to commit themselves to a plan, perhaps because of lack of experience. This is certainly not the case here.

Finally, several paragraphs are devoted to dental extractions after radiotherapy, and preradiation resection of bone in cases where palliation was the only objective.

The text is written in a readable and interesting manner, and there is an adequate bibliography. Two tables which summarize the cases handled by the author contribute to the evaluation of radiation dosage and its relation to the etiology of osteoradionecrosis, but, unfortunately, very small type makes them visually unattractive.

This small but comprehensive monograph will go a long way toward informing and guiding the reader, whether he be student or practitioner, of the varied facets associated with cancer patients who require large amounts of oral radiation, and for the small price of the monograph one literally cannot afford to be without it.—*Richard C. Baumbach.*

■ HOW TO WRITE SCIENTIFIC AND TECHNICAL PAPERS. By Sam F. Trelease. 185 pages. $3.25. Baltimore, Williams & Wilkins Co., 1958.

The technic of writing scientific and technical papers should be mastered by every researcher and should be taught to every would-be researcher, and hence to every student of dentistry. Unfortunately, dental students, graduate dentists and even research investigators are seldom exposed to formal training or even informal perusal of educational material which deals with writing scientific papers. Therefore, it is with particular satisfaction that the present volume—an outgrowth of two earlier books—is received because it gives a clear and concise frame of reference. Its 185 small pages of good sized type are not so lengthy as to be fatiguing to read, nor so brief as to fail to emphasize properly the essentials of good writing. The check list of some common errors in writing is particularly well worth reading.

One can, of course, find fault with some small details, many of which are perhaps mat-

ters of personal preference. This book is not directed especially to the field of medicine and hence is deficient in the area of medical jargon, terminology and abbreviations and thus leaves something to be desired. Because medical writing is sometimes somewhat atypical of scientific writing in general, this seems particularly pertinent.

There is a useful but by no means all-inclusive bibliography which, unfortunately, is not integrated into the text by footnotes.

It is this reviewer's opinion that it was an error to attempt any treatment at all of statistical methods in so short a volume. A total of only five pages is devoted to the exposition of the statistics involved in the standard error of the mean, the significance of the difference between means, and the adequacy of sample size. It would be far better to omit such material and provide directions to an adequate source of information, than to give the reader the illusion that these statistical technics are simple.

Over-all, however, the good far outweighs the inadequacies and hence this review is emphatically favorable.—*Austin H. Kutscher.*

■ Pharmacologie et Pharmacothérapie Dentaire (Pharmacology and Dental Pharmacotherapy). By O. Noeppel. 354 pages. Index. 3,500 fr. Paris, Masson et Cie., 1958.

The latest addition to the monographs on stomatology issued under the direction of Professor M. Dechaume is a useful listing of drugs and other remedies that are utilized in dental practice. Among those included are local and general anesthetics, analeptics, cardiovascular agents, antihistamines, antibiotics, sulfa drugs, fluorides, vitamins and hormones.

This little volume is intended to serve dental students who must know the drugs which they will be using, and practicing dentists who may use it as a guide when selecting from among the numerous drugs presently available.

The chemical formulas of the agents are included as well as indications and contraindications for their use.

There has long been a need for such a volume in the French language. The editor, Dr. Noeppel, indicates in his introduction that revisions of the volume will be issued from time to time because of the changes in therapy and the new drugs that are being discovered continually.

A complete alphabetical index adds immensely to the usefulness of the book. Any researcher in therapeutics might be wise to have this volume available, and dental schools would do well to include it in their libraries.—*Geraldine Udell.*

■ Anomalies of Infants and Children. By D. McCullagh Mayer, D.D.S., M.D., and Wilson A. Swanker, M.D. 454 pages. Index and illustrations. $12.00. New York, McGraw-Hill Book Co., Inc., 1958.

This compact volume records the common types of congenital and acquired abnormalities, and is organized as a simple reference book. The chapter, General Aspects of Pediatric Surgery, is important to any physician or dentist who operates on infants or children.

The authors, both plastic surgeons, display a sympathetic understanding of the psychological reaction of parents to children with congenital anomalies and offer constructive suggestions to meet this difficult situation. In describing specific conditions, the authors discuss in outline form the respective definition, etiology, diagnosis, prognosis, and treatment. Throughout the text, the emphasis upon and the descriptions relative to embryology are notably lucid and deserve special comment. The chapters on Skin Burns in Childhood, and Accidents to Children are important and enlightening.

This book is recommended for the library of all professional persons who deal with the physical and emotional ills of people suffering from congenital or acquired abnormalities.—*James Springer.*

■ MEN, MOLDS, AND HISTORY. By Felix Marti-Ibañez, M.D. 114 pages. Index. $3. New York, M.D. Publications, Inc., 1958.

This is a thoroughly interesting, authoritatively written book that is sure to be widely read, and to make a large contribution toward the clarification of confusion and erroneous views on the subject of antibiotics. It is a revealing index of the advances that have been made, and at the same time a demonstration that the fundamental problems have not been solved.

The reader is introduced to the history of antibiotics and the dramatic stories of their discoverers. The ideas and historical forces that moved them are described in sparkling language by a highly articulate author with clarity of thought, originality of concept and depth of interpretation. The text is principally a collection of lectures delivered at the Symposia on Antibiotics at Washington, D. C., from 1953 to 1957, and the International Symposium on Antibiotics, New York, 1954. Revisions of previous publications by the author comprise the balance of the contents.

A glance at the contents of this small volume reveals its broad scope. The past, present and future, not only of antibiotics but also of clinical medicine, scientific research, medical education and public health, are covered in a concise and intelligible manner. Among the subjects covered are the quest for the broad spectrum antibiotics, the impact of antibiotics on the medicine of the future, the history of the clinical case history and medical communication. Also included are essays on words and research, historical perspectives of antibiotics, the subject of treating the whole patient, the greatness of Fleming, and the art of translation as related to antibiotics.

The material is logically organized, well documented and clearly written. This is a thoughtful and thought-provoking book that will provide profitable reading by any physician, dentist, researcher, laboratory technician and public health worker.

The format, printing, paper and binding including the jacket, deserve commendation. The book contains a combination author and subject index, and a careful, comprehensive bibliography.—*E. Alan Lieban.*

■ HISTOPATHOLOGIE DER TUMOREN DER KIEFER UND DER MUNDHOEHLE (HISTOPATHOLOGY OF THE TUMORS OCCURRING IN THE AREAS OF THE JAWS AND OF THE ORAL CAVITY). By Erich Langer, M.D. 167 pages with 212 illustrations. Bibliography. Index. DM. 49.50. Stuttgart, Georg Thieme, 1958.

It has been the author's goal to publish a short but comprehensive compendium which shall serve as a link to larger textbooks in the field of tumors within the oral cavity.

Langer has successfully achieved this goal. The large number of clear illustrations, the short and precise descriptions in well cut sentences (not too often found in the German language), and the properly chosen terminology will be of great help to the dental and medical practitioner as well as to the student in these fields. In the shortest way possible, Langer has extensively covered the literature relative to these tumors, from Virchow (1863) to Rotter and Lapp (1958). Another outstanding and helpful feature is the arrangement of the international bibliography under the heading of each kind of tumor, at the end of the book. This special feature and the self-explanatory illustrations will enable even the non-German reader to make good use of the valuable book.—*Paul M. Doctor.*

■ Foreign Bodies in Maxillofacial Surgery. A. P. Panagopoulos, D.D.S., M.D. Am. J. Surg. 96:840 Dec. 1958.

The specialist most often concerned with foreign objects is the maxillofacial surgeon, for the head is the most exposed part of the body and gives passage to two main systems (respiratory and digestive), both of which are easy prey for foreign bodies. The purpose of this paper is not to demonstrate any particular method or technic for removal of foreign bodies but to consider the problems associated with it. The exact localization of the foreign body is extremely important and such accuracy is vital when a method or technic for removal is determined. Often the tissue will tolerate foreign bodies for indefinite periods of time, but they must be removed when there is pain, dysfunction or infection. Satisfactory results depend upon adequate presurgical preparation and determination of location.—*Myron Kaufman.*

■ Sialography in Children. Bromley Freeman. Surg. Gynec. & Obst. 107:505 Oct. 1958.

The diagnostic value of sialography, which shows the internal arrangement as well as the relationship of the salivary glands to the surrounding structures, has been stressed in numerous articles. Its limitations, indications, and contraindications have been listed. In the concentrated, complex anatomy of the head and neck of children, sialograms have been of value in extraglandular as well as intraglandular affections when correlated with a clinical examination and a good history.

The technic consists of premedication, local anesthesia of the duct openings, gradual dilation of the sphincters, and slow injection of a contrast material of low viscosity by means of simple, readily available apparatus. The use of sialography can be extended to children to aid in the diagnosis of any questionable mass around the region of the salivary glands with little trauma, either mental or physical, and occasionally may prevent exploratory surgery. Certain minor points of technic, when sedulously applied, will produce a relatively tranquil diagnostic study, often quite useful and frequently with less discomfort to the patient, technician, and operator than a chest film of the same young person.—*Irwin A. Small.*

■ Primary Malignant Melanoma of the Oral Cavity—A Review of 105 Cases. A. P. Chaudhry, B.D.S., M.S., Ph.D.; A. Hampel, D.D.S., D.M.D., and R. J. Gorlin, D.D.S., M.S. Cancer 11:923 Sept.-Oct. 1958.

Primary malignant melanoma is a rare tumor of the oral cavity. Incidence is from 0.4 to 1.3 per cent of all cases of malignant melanoma. The youngest patient in this series was 22 years old and the oldest was 90, the average being 50.5 years. Nearly 90 per cent of the patients were over 30.

Eighty per cent of the malignancies originated at the maxilla. In about 30 per cent of the patients, malignant melanoma of the oral cavity was preceded, from a few months to several years, by the appearance of pigmentation of the oral mucosa. There are wide variations in a microscopic picture of this neoplasm. The primary malignant melanoma has a tendency toward regional as well as distant metastasis. In over 50 per cent of the cases, regional lymph node metastases were evident. Most common sites of metastasis were lungs, liver, brain and bones.

In a follow-up of 61 of the patients, it was learned that 51 died from the disease, and in 24 the average duration of life after diag-

nosis was only 18.5 months. Only three patients lived more than five years. The treatment of choice is wide local excision of the tumor, combined with radical neck dissection. Of the 32 patients treated with surgery, three lived for more than five years and five lived for three years. Of the 15 patients treated with radiation, only one survived the three year period.—*Gilbert S. Small.*

■ CLINICAL EVALUATION OF A NEW ULTRA-SHORT-ACTING OXYGEN BARBITURATE FOR INTRAVENOUS ANESTHESIA. Ruth Weyl, M.D.; Baha Unal, M.D., and Y. Alper, M.D. Surg. Gynec. & Obst. 107:588 Nov. 1958.

Thiobarbiturates are known to enhance cardiac response to vago stimulation, whereas most oxygen barbiturates show a parasympatholytic action. It has been reported that thiobarbiturates are more toxic than their oxygen analogues. The chemical name of compound 25398 is 1-methyl-5-allyl-5 (1 methyl-2-pentynyl) barbituric acid. The generic name is methohexital sodium. In this study methohexital sodium was administered to 200 unselected patients. All were given preoperative sedation according to their age and general condition. The usual combination of meperidine hydrochloride or morphine sulfate with atropine sulfate or scopolamine hydrobromide was given one to one and one half hours before surgery. In addition, doses of phenergan varying from 12.5 to 25 mg. were used in one third of the patients one to one and one half hours prior to surgery.

For the intermittent intravenous injection technic, a 1 per cent solution of the compound was used. For administration by continuous intravenous drip, a 0.2 per cent solution was prepared. Other agents used for anesthesia in conjunction with methohexital sodium were cyclopropane, ether, nitrous oxide and, in some instances, oxygen alone.

Smooth, rapid induction was achieved in all instances, accompanied by a relaxation of the mandible so that a pharyngeal airway could be easily introduced. In 22 patients less than 50 mg. of the compound was used; more than one half of the patients needed between 50 and 100 mg. for induction of anesthesia, and in nine patients, between 100 and 200 mg. was used. For maintenance of anesthesia in prolonged surgery the average amount used was 400 mg. No ill effects were noted in these patients; they awoke promptly after termination of anesthesia.

There was no laryngospasm or bronchospasm noted during induction, although the drug was administered to known asthmatic patients. Hiccoughs was present in some patients, but deepening of the anesthesia or use of a relaxant overcame the difficulty. Excitement after loss of consciousness, with slight convulsive type movements, was noted in two patients. However, deepening the anesthesia by adding more of the compound put both patients into quiet clinical anesthesia. There was no postoperative excitement in these patients. There was no local irritation or thrombosis noted at the site of injection in any patient, even in the one in which massive infiltration occurred in one arm during a spinal fusion. A short period of apnea occurred occasionally after rapid injection of the compound, and depressed breathing had to be corrected in eight patients by positive pressure respiration with oxygen.

There were four complications noted in this series, all in very poor risk or cardiac patients. The complications were in the nature of delayed reaction after surgery, one case of pulmonary edema and two of hypotension.

Methohexital sodium is a white crystalline solid which is very soluble in water. It is a stable and aqueous solution and the pH ranges between 10 and 11. In this series it appears to be approximately three times as potent as thiopental sodium and was utilized approximately three times as rapidly as thiopental sodium. Methohexital sodium appears to be a safe agent in the hands of the experienced anesthetist.—*Irwin A. Small.*

Announcements

■ Oral Surgeons Plan Meeting Prior to A.D.A. Centennial Session

Plans for the 41st annual meeting of the American Society of Oral Surgeons have been announced by Robert B. Shira, chairman of the committee on program. The meeting will be held September 9-12 at the Biltmore Hotel, New York. Noted clinicians of this country and abroad will present a program of unusual interest.

Participants in the program will include Herbert J. Bartelstone, O. V. Batson, Sindar Bhaskar, C. J. Brown, Donald Cooksey, Adrian Hubbell, Harold Krogh, Albert B. Lowenfels, Donald MacClennan, Stephen Mallett, Lowell B. McKelvey, Leonard Monheim, George Morin and L. Lazlo Schwartz.

Business sessions will be limited to afternoons on two days, September 9 and 12. The afternoon instructional courses will be offered Thursday and Friday afternoons, September 10 and 11, and scientific programs are scheduled for the first three mornings of the session.

Immediate housing reservations (Biltmore Hotel) should be made by all members of the Society by application to the Housing Bureau, American Dental Association, P. O. Box 5440, Chicago 7.

■ Boston University Given $25,000 for Research Lab

Establishment of a research laboratory for the department of stomatology of the Boston University School of Medicine has been made possible by a $25,000 gift from Boston industrialist George Sherman. The announcement was made jointly by president Harold C. Case of the University and Dr. Chester S. Keefer, dean and director of the School of Medicine.

The laboratory, to be known as the George and Beatrice Sherman Research Laboratory, will be located in the school's $3,000,000 medical research building which is now under construction. The building is scheduled to be completed in the fall of 1960. Henry M. Goldman is chairman of the department of stomatology.

Mr. Sherman, president and treasurer of Sherman Paper Products Corp., Newton Upper Falls, Mass., is an honorary trustee of both Newton-Wellesly and the Jewish Memorial Hospitals.

■ 'Atlas of the Mouth' Chosen for Top Honors in Exhibit

The recently issued second edition of *Atlas of the Mouth*, prepared by Maury Massler and Isaac Schour and published by the American Dental Association, has been selected as a top honor book in the 10th Annual Exhibit of Chicago and Midwestern Bookmaking. The announcement was made by the executive committee of the Chicago Book Clinic.

Three traveling exhibits of the winning books will be displayed by major midwestern libraries during the remainder of the year.

■ Souder and Hatton Novice Awards Received at Dental Research Meeting

Ralph W. Phillips, a professor at the School of Dentistry, University of Indiana, received the Wilmer Souder Award at the 37th general meeting of the International Association for Dental

Research in San Francisco in March. This award is conferred annually on an individual who has made outstanding fundamental contributions to the development of dental filling and restorative materials.

Richard L. Hoffman, a graduate student in dentistry at the Chicago Professional Colleges of the University of Illinois, received the Hatton Novice Award for his studies on transplanting teeth in animals.

A citation of honorable mention was made to Benjamin F. Hammond, School of Dentistry, University of Pennsylvania, for a report on bacterial nutrients in human saliva.

■ American Association of Dental Schools Elects

Robert W. McNulty, dean, School of Dentistry, University of Southern California, was elected president of the American Association of Dental Schools at its 36th annual session held in San Francisco in March.

Other officers elected were: president-elect, Raymond J. Nagle, dean, College of Dentistry, New York University; vice-president, Lester W. Burket, dean, Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. George W. Teuscher, dean, Northwestern University School of Dentistry, and Harry Lyons, dean, School of Dentistry, Medical College of Virginia, were elected to continuing membership on the executive council of the Association, and O. M. Dresen, dean, School of Dentistry, Marquette University, and Maurice J. Hickey, dean, University of Washington School of Dentistry, were named to new positions on the executive council, the managing body of the association.

Mr. Reginald H. Sullens was appointed secretary-treasurer of the association, and Marion W. McCrea, acting dean, School of Dentistry, University of Minnesota, was named to the office of editor.

■ 16th French Congress of Stomatology October 5-10

The 16th French Congress of Stomatology will be held in Paris October 5-10. The four major subjects to be covered in the scientific session will be: (1) traumatic lesions of the middle section of the face encountered in traffic accidents; (2) allergic manifestations in stomatology; (3) height of the lower part of the face in orthodontics, and (4) traumatic lesions of the upper incisors.

Further information can be obtained from the general secretary of the congress, Dr. Roger Bataille, 43 Rue de la Chaussée D'Antin, Paris IX, France.

■ Reserve Officers Can Earn Credits at Centennial Session

Training and retirement point credits may be earned by U. S. Army Medical Service Reserve officers for attending certain sessions of the American Dental Association's Centennial Session in September, it was announced at Headquarters, XIII U. S. Army Corps (Reserve) at Fort Devens, Mass.

Credits will be given provided attendance at a session is for a period of not less than two hours and registration at each session is accomplished with the individual designated by the Commanding General. It was pointed out, however, that not more than one credit can be granted for any single calendar day.

■ Centenary Meeting of the German Dental Association

The dental profession of Germany will celebrate the 100th anniversary of the creation of the German Society of Dentistry within the congress program prepared for the 14th "Day of Dentistry" (Deutscher Zahnärztetag). Both celebrations will take place at the new Congress Hall in Berlin September 3-6.

Professor Ewald Harndt, chairman, and Erich Müller, president of the German Dental Association, extend to the dentists of all countries an invitation to attend the centennial meeting. The preliminary program includes scientific sessions, exhibitions of the German and other countries' dental industry and social events such as banquets, fashion shows and sightseeing.

Requests for room reservations can be made to the meeting's secretary, Rolf Braun, Universitätstrasse 73, Köln-Lindenthal, Germany.

■ International Academy of Oral Pathology to Meet

The International Academy of Oral Pathology will hold its first scientific conference September 14 at the New York Academy of Medicine in New York City.

The morning session will be devoted to an analysis of the conditions that predispose the oral mucosa to cancer. Col. Joseph L. Bernier of the Armed Forces Institute of Pathology will serve as moderator. Professor Martin Rushton, Guy's Hospital, London, Professor Robert Bradlaw, University of Durham, Newcastle upon Tyne, Lester R. Cahn of Columbia University and Reidar Sognnaes of Harvard University will act as discussion leaders.

In the afternoon the subject of the conference will be the problem of disturbed odontogenesis in relation to tumor formation. Dr. Cahn will serve as moderator and topic discussers will be Col. Bernier, Jens Jorgen Pindborg of the Royal Dental College of Copenhagen, and Kurt H. Thoma, professor emeritus of Harvard University. Harold Hillenbrand, secretary of the American Dental Association, and Henry A. Swanson of Washington, D.C., are serving as consulting associates.

■ Metropolitan Conference of Hospital Dental Chiefs

All dentists on hospital staffs are invited to attend a special meeting of the Metropolitan Conference of Hospital Dental Chiefs to be held during the Centennial Session of the American Dental Association. The meeting will take place from 3:30 to 5:30 P.M. Monday, September 14, in the Regina Coeli Hall of St. Clare's Hospital, 427 West 52nd Street, New York.

Outstanding dentists have been scheduled to speak on "Progress in Hospital Dentistry through Regional Organizations."

Further particulars can be obtained from I. E. Gruber, chairman, special meeting committee, 12 Harmon St., Brooklyn 21.

Editorial communications

■ ORIGINAL COMMUNICATIONS—This journal invites concise original contributions on hospital dental service and in all phases of clinical and experimental surgery of the mouth and associated structures, including roentgenology, diagnosis, anesthesia and oral surgical pathology. Articles are accepted for publication with the understanding that they are contributed solely to the JOURNAL OF ORAL SURGERY, ANESTHESIA, AND HOSPITAL DENTAL SERVICE. All manuscripts are subject to editorial modification. Neither the editors nor the publishers accept responsibility for the views and statements of authors expressed in their communications.

■ MANUSCRIPTS—Manuscripts submitted for publication should be sent to Fred A. Henny, Editor, Henry Ford Hospital, Detroit, Michigan.

Manuscripts should be typewritten on one side of the paper only with double spacing and liberal margins. The author's name and abbreviated title of the article should appear at the top of each manuscript page. The original should be sent to the editor and a carbon copy retained by the author. Manuscripts will not be returned if accepted for publication.

References should be placed at the end of the article and should conform to the style of the Quarterly Cumulative Index Medicus; viz., name of author, title of article and name of periodical with volume, pages, month and year. They should be numbered and should appear in the same order as that of the superior figures inserted in the appropriate positions in the text.

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